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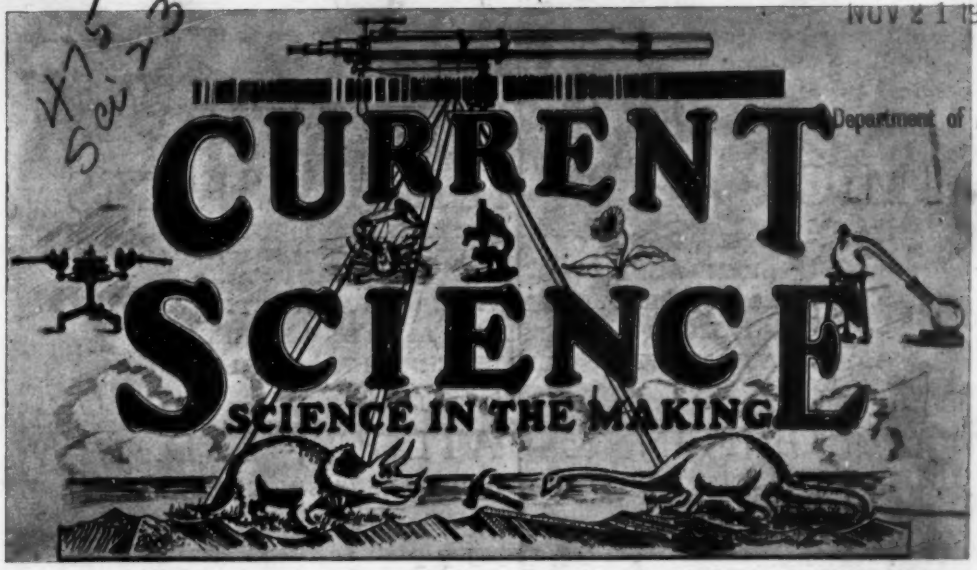

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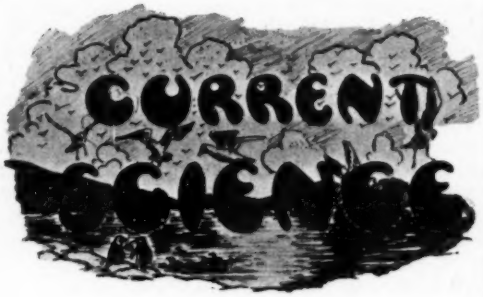

Vol. II] OCTOBER 1933 [No. 4

CONTENTS.

PAGE

The Marine Fisheries of India 117

Alfred Bernhard Nobel 122

Biology: Its Importance in Modern Education. By P. W. Gideon, M.A. 123

Lacertilian Respiratory Mechanism. By C. P. Gnanamuthu, M.A., F.Z.S. 124

Letters to the Editor:

The Panjal Trap. By K. K. Mathur and S. N. Wakhaloo 126

On the Incoherence of Fluorescent Radiation. By S. M. Mitra 126

Seasonal Variations (Sexual Cycle) in the Testis of *Rana tigrina*. By J. J. Asana and R. J. Kharadi 127

Lint Color in Asiatic Cottons. By V. R. Ayyar and R. B. Iyer 128

A New Method for the Separation of the Two Components of Amylase. By K. Venkata Giri 128

The Homoxyleæ and the Ancestry of Angiosperms. By K. M. Gupta 129

Female Gametophyte of *Argemone mexicana* Linn. By A. C. Joshi 131

Oil-Soluble Vitamins in some Pulses and Fishes of Bengal. By H. N. Banerjee and N. C. Nag 131

Recent Researches on the Ætiology of Goitre .. 133

The British Association—Leicester Meeting, 1933 135

Research Notes 145

Calcutta Fish Depot 148

Science News 149

Reviews 151

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The Marine Fisheries of India.

A RESOLUTION to start research in pisciculture intended to be moved by Mr. R. V. Jadhav at the last session of the Legislative Assembly was disallowed by the Governor-General on the ground that the subject of fisheries belongs to the transferred half of the Provincial Government. To people who live in countries where a unitary system of Government prevails, the division of administrative functions between the Central and Provincial Governments and the subsection of responsibilities of reserved and transferred halves of provincial governments must be perplexing. It is difficult to discover any scientific basis in the allocation of the Departments of Land Revenue and Forests to the reserved half and those of Education, Medicine, Industries and Fisheries to the Ministers responsible to Provincial Legislature. The Scientific departments, quite as much as the Military and that of Foreign Affairs. have an all-India importance in promoting the moral and material welfare of the people as a whole; division of the interests of the country as administered at present cannot accelerate their progress at the rate and in the direction indicated by national aspirations. Constitutional reforms devised to satisfy the political ambitions of the provinces, frequently fail to secure the advantages of a Central authority directing the uniform progress of the nation-building and wealth-producing departments, and the transfer of Education must tend to lop-sided development and that of Fisheries, to wasteful duplication of effort.

India has an extensive coast line and the sea is full of wealth, capable of providing lucrative employment for millions of people and of adding considerably to national prosperity. We have before us two interesting documents, the Report of the Committee on Fisheries in Madras and the Report of Mr. H. T. Sorley on the Marine Fisheries of the Bombay Presidency and we are convinced that the views expressed by them can only point to the necessity of restoring the post of the Inspector-General of Fisheries formerly held by Dr. Francis Day and of the taking over by the Central Government of the administrative control of the Department. Discussing the problem of scientific research, the Madras Committee come to the conclusion that "it is evident to the Committee that research

is urgently needed in every branch of the department's work before any further appreciable progress can be made" but Mr. Sorley advises the Bombay Government "to leave severely alone matters like research and the development of by-industries of fishing" as one of the lessons to be learnt from the experience of Madras. Mr. Sorley, however, recognises that the gaps in the knowledge of the conditions and habits of life of the Bombay marine fishes must make it difficult to deal with fishery development on its scientific side, but hesitates to recommend even the establishment of a Fishery Department in Bombay on the lines analogous to that of Madras. Since the expenditure of public funds on the provision of a fishery research institution is deprecated by Mr. Sorley because the public is not generally prepared to respond in a practical way, he suggests that research should, however, be the proper function of the University and the Bombay Natural History Society which should, in the first instance, collate and make available for the education of the public the results of such scientific research on Fisheries as has been carried out in India and elsewhere during the last thirty years. The function of the State in fostering the fishery development according to Mr. Sorley is partly by encouraging practical methods of fishery technique and partly by conducting scientific research in the 'narrower sense'. The spirit and scope of such research are discussed in a short paragraph which forms the concluding part of the report.

The development of the fisheries industry is part of the wider problem of the food requirements of the people and in a country like India where the diet of the people is as diversified as their language, no amount of propaganda in favour of "Eat More Fish" will overcome the deep-rooted religious convictions. According to the Hindu conception the primary function of food is to promote a clear understanding and suppress evil passions which retard the progress of the soul and vegetarian diet is believed to assist man in clearing his mind and refining his emotions. This was not, however, the ideal of the Aryan progenitors. Whatever else the reformed diet may or may not have done, it has gradually undermined the physique of the people, deprived them of the spirit of adventure and of martial qualities and paved the way for the Sarada Act. The physical efficiency of the people depends on a well-balanced diet providing the proper nutritive value and standard requirements of the normal individuals of both sexes and all ages in proportion to the work they are engaged in. The value of science to the people is that it gives prescience and the nation that ignores the results of the science of dietetics must be content to remain timid, inefficient and disorganised. We can foresee a time when the food of orthodox India will conform again to Aryan standards and Manu's permissive law, "Yet the two fish, called *Pát-hína* and *Róhíta*, may be eaten by the guests when offered at a repast in honour of the Gods or manes; so may the *Rájíva*, the *Sinhathunda* and *Sasalka* of every species." If the daily ration of India is more universally and generously supplemented by the produce of the sea, perhaps the severity of the famines which periodically overtake the people would be mitigated to an appreciable extent.

The policy of the Local Governments has been to make the Fisheries Department pay its own way, but the Agricultural Commission in recommending that a longer view be taken has pointed out that the necessity of improving the daily diet of the rural population implies a prosperous and well-conducted fishery industry which is a source of social and material wealth to the State. The annual value of the output of the fisheries in Japan is £ 30,600,000 and that for the Bombay Presidency is estimated at Rs. 80,30,000 or £ 5,35,333. The low economic position of the industry is vividly portrayed by the fact that only 0·57 per cent. of population is engaged in catching fish and the annual catch per fisherman amounts to 1·55 tons whose total value is Rs. 66–3–8. In the United Kingdom the total annual catch per head of fisherman is nearly four times the output of the Indian and its estimated value is Rs. 1,060–3–0. In recent years there has been a falling off in the fishing population and according to the recent census figures the drop in the Bombay Presidency is slightly over 22·3 per cent. and in Karachi it is a little under 50 per cent. This depletion is all the more significant when we compare the relative proportion of people using fishing as a source of livelihood to that engaged in agricultural and farm occupations; the former is 1·1 per cent. of the latter. Naturally the fishermen must in the long run give up their hazardous and non-remunerative occupation and adopt others with higher wages offered by the mills and factories in the cities. It is

surprising that in view of the gravity of the situation with which the fishery industry is confronted, Mr. Sorley's recommendations for its amelioration and advancement should be conceived in terms which offer no hope for the future development of this important source of national wealth.

It seems to us that the general principles underlying the organisation of an important national concern like the fisheries industry have not been stated in the report from the broad statesmanly point of view. Even the present poor standard of comfort and convenience enjoyed by Indians of average means is due to the raising of the productive capacity of the individual workers. This is accomplished mainly by the specialisation of effort which a particular profession permits and every progressive industrial organisation involves the assemblage and co-ordination of a complete outfit of mechanisms and processes in the successful operation of which an increasing efficiency and trained skill are demanded of the individual. A fisherman has to be inventive and this faculty is instigated and nourished by the research department. With increasing population, the maintenance and improvement of living must obviously depend upon our ability to continue the industrial methods of the community. No industrial progress can be achieved without the constant acquisition of new knowledge which points the way to better control of operations, to new and better processes in evolving new products and new uses of them which extend the market. We must first produce new articles, find out their uses and extend their sale. This principle is applicable to the fisheries as much as to any other industry. The complexity and interdependence of modern industrial organisations and the keen competition between nations demand that any industry,—even fisheries,—must consciously and unremittingly explore the scientific facts and principles and apply them in its operations.

The first step in furthering the interests of the fisheries industry is to improve the professional knowledge and methods of the fisherman and for this purpose the Madras Committee urge on the Local Government the immediate need to undertake the compilation of a fisherman's chart for the South Indian waters comparable with Close's chart for the North Sea. In order that the survey may be completed in ten years, the Committee recommend the purchase of an additional trawler and the appointment of a full complement of technical and scientific staff and a complete equipment of the boats for the expedition. Without a chart and a key to give information to the fishermen about the depth of the waters, nature of the bottom, tides and currents, the occurrence and abundance and kinds of fish in any charted locality and nets and gear appropriate to the occasion, the whole industry must be empirical and success must be fortuitous. Mr. Sorley is not unaware of these facts. He says, "on a full consideration of all the circumstances, I am convinced that there is no case for establishing a Department of Fisheries in Bombay Presidency. At most the Department of Industries might be slightly strengthened. If the fish curing yards are taken over by the Government, the appointment of an Assistant Inspector will be sufficient." This is caution bordering on timidity and the acceptance of these recommendations by the Government of Bombay will absolutely retard the progress of fisheries industry, continually diminish the economic and social status of the fisherman community and certainly deprive the authorities of a fruitful source of income.

The attitude of Mr. Sorley towards fishery research is definite. He advises scientific research in the "narrower sense" of the word "Science" and "there is no need for the Bombay Government to indulge in general scientific research on fisheries". If, however, research is to be adopted as a policy, he observes that "it should be confined to certain definite questions likely to promise results of economic importance within a reasonable time and it would be advisable to fix a time limit within which research must be completed." This suggestion has the advantage of "a contract being signed with the scientist engaged for the investigation of definite problems placed before him." This is not all. "Government should itself control exactly from the start the terms of reference, the system of investigation and the amount of public money to be expended each year." In the earlier sections of the report, Mr. Sorley points out that "the Madras Fisheries Department has, in the course of its existence, by means of its bulletins, collected a mass of information of high scientific value relating to all aspects of the fishing industry and fishing research. In Bombay nothing has been done in this way and scientists have to start from Day's

'Fishes of India'. However, the fishing development is to be undertaken according to Mr. Sorley without much expenditure of public money, but by private individuals, public bodies, learned societies, the University and Government and with such inter-provincial and international co-operation as is procurable.

The Madras Committee observe that "it is evident that research is urgently needed in every branch of the department's work before any further appreciable progress can be made." Dealing with the reorganisation of the work of the Department of Fisheries, the Committee point out that "the most important part of it which is immediately needed is extensive research of a two-fold nature—(1) relating to observations on which the preparation of a fisherman's chart should be based; (2) relating to the correlated biological observations." For the successful prosecution of scientific research on fisheries recommendations are made for the appointment of a highly qualified staff: a Fisheries Biologist, a number of assistant biologists for marine and fresh water investigations, a biochemist and a chemical engineer on suitable salaries, each officer to be provided with fully equipped laboratories. In making these recommendations "the Committee fully realise the magnitude of the expenditure involved, but as the branch of work has so far resulted in substantial profits to Government" the proposals are expected to cover the entire cost of the maintenance of staff and research stations and accordingly the Committee have no hesitation in suggesting the costly developments for adoption by the Government as their approved policy.

Mr. Sorley's recommendations are entirely out of date and are based on a fatally wrong conception of science and research. A 'narrow' and 'broad' sense of science is distinctly mediæval. The fisheries problems are numerous and complex and refer to Oceanography, Meteorology, Marine Biology, Biochemistry, Dietetics, Engineering, Statistics, Technology, Socio-economics and Subsidiary Industries, and research in every one of these departments must be intense and continuous: we doubt if any one of these problems can be isolated for study on a contract basis and the last word pronounced on the completion of its investigation. It is totally irrelevant to suggest that Government should direct scientific research. It is untenable to suppose that fundamental research, on which industrialt research is to be based, can be entrusted to private individuals and public bodies to be carried on without expenditure of public funds. The Universities can supply biologists to undertake fishery research, but must refuse to accept the responsibility of conducting investigations into the complex fishery problems. Even the fundamental research of the highest type is best conducted in the laboratories of Fisheries Department and on board the trawlers. The quality and effectiveness of all industrial research rise in proportion to the use it makes of the facts and principles of pure scientific investigations. None of the enquiries can be conducted on the basis of Mr. Sorley's recommendations.

A great deal of information on practically every one of these subjects is rendered available by the investigations of the Fisheries Department of Japan and European countries where biological research is regarded as of supreme importance and its initiative and guidance devolve on State Department of Fisheries. In India every problem is of importance and the knowledge accumulated by the Fisheries Department, Madras, on the one hand and that, on the other, obtained by the officers of the Zoological Survey of India would form a suitable starting point of fresh investigations. Commercial expansion of fisheries as an industry is possible only by concentrated work on technological, chemical and engineering problems, with special emphasis on researches on the comparative nutritive value of marine and fresh water fishes consumed as food by the Indians. The problem of preservation and rapid transportation of marine fishes in a tropical climate is fraught with peculiar difficulties and the processes of freezing the animals in refrigerators and drying them with salt, and canning them in sealed tins, require investigation in respect of the vitamin content of specimens so treated under the Indian climate. On the chemical side, the possibilities of hydrogenation of fish oil which may be converted into wholesome edible fat or into solid fat valuable as soap stock and analyses of fish guano and other fertilisers with reference to the Indian soils and plants should receive simultaneous attention with a view to supplying the Indian agriculturist with sufficient quantities of cheap manure.

Pasteur's germ theory of disease will sooner or later be supplanted by the food theory of disease. The problem of feeding

the rural population is of all-India importance and the responsibility of initiating investigations into the nutritive and therapeutic value of the various articles of food used in India must belong to the Central Government. It does not seem that the broad aspects of the question—the problem of making the production of food in the country equal to the necessary consumption,—has formed part of the definite policy of the executive of administration. In India there is no equitable distribution of food on a physiological basis and an investigation into the national requirements of calories and proteins and to what extent the produce of the land is to be supplemented by other sources in order to maintain the people at the maximum physical efficiency is a problem for the consideration of the Government of India which cannot escape from the obligation of providing the people with the means of educating and feeding themselves. It is not improbable that the transformation which is being gradually introduced into the diet of the orthodox communities will become more pronounced with the increase in the number of young men returning from an education abroad and when the people realise in an increasing measure the advantages of a mixed diet for the preservation of their health, protection of the sanctity of their homes and defence of their country, we have little doubt that fish and fowls will be more generally added to their daily rations. In the meantime the agricultural population, the artisans, and others engaged in hard manual work should have a sufficient supply of cheap fish and if the means of distribution is developed, the consumption of this article of food will increase ten-fold.

The increased expenditure of public funds involved in the establishment of Fisheries Department in all provinces, with research laboratories under the control of the Central Government would be perfectly justified, because it will provide employment for a large number of highly trained scientists who at present are unemployed and when the Government take over the management of the subsidiary industries and develop them, educated young men can find useful occupation in larger numbers. It is not so much the social stigma supposed to be attached to the profession of fishermen that is keeping back others from engaging in it as the hazard to life and the terrors of an angry sea that make people prefer to eke out a precarious existence on land. The simplest and the easiest mode of elevating the social and economic position of fishermen and of removing from the minds of others false notions of the dignity of labour is to take out school children on weekly excursions on the sea and large rivers, and enable them to watch the fishing operations. As soon as they get over the inconveniences of sea-sickness, and feel braced up by the sea breeze, they will shake off the fear and become interested in the capture of fish whose colour, form and variety will amuse and instruct them. They should be taken to visit the industrial centres where fish is smoked, salted, and canned and by-products are prepared. After repeated visits they will get used to the offensive smell and unfamiliar sight of the place and if they are encouraged, they will be delighted to lend a helping hand in the operations. Besides being part of their education, the interest in the sea and its contents so early implanted in the young mind, may develop later into a professional passion. The prejudices of an adult mind are hard to remove, but the juveniles form an excellent material for training for any walk of life. The increased association of other caste men with the profession of catching fish will tend to its elevation. If the Departments of Education and Fisheries are under the control of the Central Government, a comprehensive scheme of co-operation on a nation-wide scale with sufficient provision of finance for effectively carrying it out, can be formulated and put into execution. The money invested in a programme of this description will be in the nature of profitable investment.

Mr. Sorley's report without its recommendations in respect of organisation of the Fisheries Department, the expansion of the industry and the institution of scientific work including general research in all branches of the department, is certainly a clever document and the timid suggestions made in regard to the fishery development must be due to an inadequate appreciation of the fact that "research is the mother of all industries and it may even dispute with necessity for the parenthood of invention." We hope that the Bombay Government will draw lessons from the Report of the Madras Committee far different from those indicated by Mr. Sorley and that the Central Government, realising the immediate importance of taking over the Fisheries Department

under their jurisdiction, will appoint a Commissioner of Fisheries for co-ordinating the efforts of the local governments and elevating the industry into an effective instrument for enriching the social and material wealth of the Indian Empire.

Alfred Bernhard Nobel.

(1833—1896.)

OCTOBER 21, 1933, marks the Centenary of the birth of Alfred Nobel. At the age of sixty, in 1893 when the University of Upsala conferred upon him the honorary degree of Doctor of Philosophy, Nobel at a request for his autobiography wrote thus: "The undersigned was born at Stockholm on 21st October 1833; he acquired his knowledge in private studies and did not attend any secondary school. He devoted himself particularly to applied chemistry and discovered explosives known under the name of dynamite and smokeless powder called ballistite and C. 89. Since 1891 he has been a member of the Royal Swedish Academy of Sciences, and is also a member of the Royal Society (London) and the Societe des Ingenieres Civils in Paris. Since 1880 he has been a Knight of the Nordstjarne Order. He is an Officer of the Legion of Honor. Sole publication: a lecture in the English Language which was awarded a silver medal."

Nobel's passion for researches on chemical explosives is the result probably of his association with his father Emmanuel Nobel who at an early age went over to St. Petersburgh where the father and son were engaged in the construction of submarine mines and torpedoes. Some of the wonderful achievements of the modern engineers are rendered possible by the invention of the explosive compound dynamite which is distinctly a land-mark in the progress of civilisation and probably the greatest next to the Printing Press. Dynamite was followed by blasting gelatin and years later by ballistite, one of the earliest of the nitroglycerin smokeless powders, the precursor of cordite. These inventions, including artificial India rubber, brought Nobel an immense fortune and also vexations of law suits. His exploitation of the Baku oil fields, in collaboration with his brothers, added considerably to the former. He held 129 patents in Britain and controlled fifteen explosive factories in different parts of the world and left behind him £ 1,680,000.

This amount is the foundation of five annual prizes of about £8,000 to £10,000 to be awarded for the most important discoveries in Physics, Chemistry, Physiology or Medicine and also for literary works of an idealistic tendency and for distinguished public service in the cause of Peace. The benefits of the foundation are open to all nationalities and are without restrictions of sex. The first four are awarded by the Swedish Academy and the fifth by the Norwegian Storthing. Dr. Rabindranath Tagore and Sir C. V. Raman are among the recipients of this greatest international honour.

Though Nobel discovered explosives he was a sensitive, nervous man always poor in health. He remained a bachelor and was of lonely disposition. He had a great horror for wars and is reported to have said, "I wish I could produce a substance or a machine of such frightful efficacy for wholesale devastation that wars should thereby become altogether impossible." Is there no other way of abolishing wars ?

Biology: its Importance in Modern Education.

By P. W. Gideon, M.A.,
Department of Biology, Karnatak College, Dharwar.

(Continued from Vol. II, No. 3, page 85.)

TO-DAY the world has realised that the human race is probably at the dawn of racial suicide, due to a world-wide ignorance of the common laws necessary for the prevention of disease and the eradication of important animal and plant pests.

Almost the whole of the literate and educated population of the world think man the dominant race amongst living things. It is only the very small minority who know the tremendous warfare raging in life's struggle for existence, and see the human race just able to hold its own. The human stock is no more dominant than the other stocks of animals and plants, the only difference being that while the human race is conscious of its dangers and consciously tries to get the better of its enemies, the rest of life enters into this tremendous struggle, unconsciously. It is well for us to remember that our powers of reason and consciousness to dangers around us are our only weapons in this struggle, whereas the remarkable powers of regrowth, the enormous powers of reproduction, protective colouration, and mimicry are a few among the millions of adaptive devices Nature has bestowed on her children in preserving the individual for the perpetuation of the race.

To man alone is given the power of reason and he alone is conscious of his position amongst living things. To be ignorant of this power or to fail to use it, is to lose hold of our place in life's struggle. Herein lies our real danger. Almost the whole human population is in total ignorance of the dangers that beset us, and fall an easy prey to enemies, millions dying chiefly through disease.

In our present state of civilisation, where the efficiency of specialisation has reached a very high standard, modern man has become a one-sided being, leaving the problem of disease and its cure to a small body of specialists—the medical men. Whatever may be the argument for leaving the various arts and crafts to specialists, the entire leaving of the problem of disease to a small body of specialists has been man's undoing; since the relegation of such powers interferes with man's fundamental rights in his struggle for existence. In Nature's struggle, it is the race as a whole that has to fight and no amount of specialisation of a group of individuals to cope with the natural dangers threatening the race can be of much avail. There must, of course, be a body of men trained as specialists for the detection, prevention and eradication of man's enemies, but side by side, there must be the means for educating the whole of humanity in the essentials of these discoveries, which would provide an escape from the penalties of ignorance.

The imparting of such knowledge is only possible through a study of Medical, Economic and Social Biology, and a careful selection of such essential features as would have a practical value in protecting the health of every citizen and making him take a living interest in all the efforts used for fighting the annual drain of human life and wealth. This should form a necessary part of every nation's educational policy.

The recent National Conference organised by the British Social Hygiene Council to discuss the place of Biology in education, emphasised the necessity for the education of every citizen in the understanding of biological ideas so that problems of industry, economics and population should not be beyond our control. It also stressed the point that in every stage of the education of both boys and girls Biology must have its place. The present demand all over the world is for an education that would equip every citizen with sufficient knowledge of the cause, spread, and prevention of the common and dangerous diseases, and of the animal and plant pests which cause damage to crops, livestock and other goods of value to mankind; that would encourage the production of offspring among those people most richly endowed by Nature, and that would devise practical methods for cutting off the inheritance of persons who are socially inadequate.

India inherits the usual disadvantages that a tropical climate bestows. She is the home of many diseases and unfavourable conditions. And the education of her children towards a biological outlook, that would

encourage and support every effort in the eradication of all factors detrimental to the progress of humanity, should engage her immediate attention.

The work of educating the public must primarily rest with the educational bodies throughout India. The study of Zoology and Botany, stressing such points as are essential to human welfare should be of vital importance to every boy and girl, man and woman leaving our schools and colleges. Biology should be one of the compulsory subjects in the Primary, Secondary, and even the first two years of collegiate education.

At the recent Matriculation Examination of the Bombay University, out of 17,000 candidates, only 63 offered Zoology and Botany, and 171 Physiology and Hygiene as their optional subjects. The remaining 16,750 students—the majority of whom would perhaps never again come into contact with educational facilities—must plod their tragic way through life with practically no idea of life and its dangers, the cause of disease, its transmission, cure, prevention and eradication.

Imagine 17,000 students facing life's dangers with a knowledge of History, Geography, Algebra, Geometry and Arithmetic. While in no way trying to minimise the value of these subjects, this is only an instance to show how, in the entire exclusion of Biology as one of the compulsory subjects, we have failed to recognise the true values of things.

The universal realisation of the need for Biology in the educational policy of every nation will have a profound and far-reaching effect in the world of the future, when health and prosperity will take the place of disease and poverty.

Lacertilian Respiratory Mechanism.

By C. P. Gnanamuthu, M.A., F.Z.S., *Madura*.

THE part played by the buccal floor, and therefore the hyoid and its muscles, in co-operating with the thoracic respiratory mechanism has been minimised if not lost sight of by previous workers like P. Bert, C. Heinemann, E. Siegurt and E. Goppert. An estimate of the exact character and degree of buccal participation in pumping air in and out of lungs is necessary to understand reptilian respiration as a whole and to trace its evolution from the mechanism of pulmonary ventilation of amphibia.

The present note on this subject deals with the respiratory mechanism of only three lizards—a geckon, a varanid and an agamid. The buccal floor of members of geckonidæ rises and falls rhythmically and it can be easily noted that these oscillations are as frequent as the expansion and contraction of the chest. That those movements of the buccal floor are not passive—not the secondary effects of the going out and coming in of air from the lungs—was proved by the following experiment. A Geckon (*Hemidactylus* sp.) was tied down to a board and about 0·3 to 0·5 c.c. of Novocain (Bayer Meister—Lucrius) was injected subcutaneously into the throat region. The trachea was cut when the part was completely narcotised. Movements of the buccal floor continued as regularly and as frequently as those of the thorax, though the air from the thorax could no more enter the buccal cavity. This shows that the buccal floor movements form a feature of the respiratory mechanism as active and primary as the contraction and dilation of the thorax.

It is interesting to watch the buccal floor lower when the thorax dilates and rise when the chest contracts. The fact that the buccal cavity and the thorax contract together furnishes additional evidence to prove that the buccal movements are active and independent of those of the chest. The movements are so quick that the fact that they do not alternate may not be easily detected unaided. To facilitate observation the following apparatus was devised. A lizard was tied down to a board with the ventral side upwards. Small strips of glove rubber glued to the lower ends of pieces of wires were placed, one on the chest and another on the buccal floor. The upper ends of the vertical wires communicated the movements to the short arms of long light wooden levers. Each lever had a knife edge fixed to it, and this knife was allowed to rest in a 'V' shaped groove of a wooden piece clamped to a stand. The lever was perfectly counterpoised about the fulcrum and care was taken

that the lever did not exert too much pressure on the buccal floor. When the buccal floor (or the chest wall) rose and fell, the tips of the levers dipped down or tilted up. A thin copper wire was previously wound round the long arm of each lever from the fulcrum to the tip. The free end of the wire at the tip of the lever was made to just touch another piece of copper wire (fixed to a stand) whenever the tip of the lever was lifted. The other ends of these two wires were connected to the poles of an electric battery so that a circuit was completed whenever the free ends of the two wires touched. Electric bells were introduced into the circuits and their sounding facilitated the observation of the synchronous movements of the levers connected to the buccal floor and the thorax. Later styles were fixed to the hammers of the two electric bells and their vibrations were recorded on smoked paper revolving round two drums. The record obtained showed that the contacts made by the levers connected to the buccal floor and to the thorax were simultaneous. This method of recording the buccal and thoracic movements had to be resorted to because the mouth floor and chest wall movements appeared too weak for ordinary graphical records.

The above experiments clearly show that the buccal cavity and the thorax contract together and dilate together and that these movements of the buccal and thoracic wall are both active and due to the effort of independent muscles. The rôle the buccal floor plays in the respiratory mechanism appears to be this: Owing to the weak character of the muscles of the buccal floor, the strong contraction of the thorax, expelling air from lungs would bring about the inflation or lowering of the mouth floor. When next the thorax relaxes the air inspired would be this impure air in the buccal cavity especially when the thoracic contraction and expansion follow each other so rapidly. This is avoided by the active and simultaneous contraction and expansion of the mouth floor. When the thorax contracts, the tongue and floor of the mouth are raised up through the aid of the transverse and hyoid muscles and the vitiated air from the lungs is thus expelled direct.

In calotes and varanus, however, the buccal cavity appears to participate only during the extraordinary respiratory movements. If a calotes or varanus were tied down to a board with the ventral side upwards and if the throat region were watched carefully, it will be seen to move very slightly. These movements, however, alternate with those of the thorax. If a thread is stitched through the skin in this region and attached to a pin driven close to the fulcrum of a lever (described before) these movements can be recorded. That these movements are passive and secondary and due to the air going out and coming into the thorax, can be proved by cutting the trachea after narcotising the region by a subcutaneous injection of novocain. The movements cease. A little later, however, when this operation brings on laboured respiration the buccal movements can be seen to be spasmodic and vigorous and to synchronise with the movements of the thorax. The same result could be obtained by plugging the nostrils of a calotes with wax or by tying the thorax with a piece of twine and thus restricting its movements. By means of levers which have styles attached to their tips, the movements of the mouth floor and thoracic wall were recorded on smoked paper. The graphs showed that the mouth floor and chest wall contracted or expanded together during laboured respiration. (While these records were made, the mouth of the calotes was kept open by a piece of stick thrust between the jaws. By this means the expired air was prevented from affecting the buccal movements.)

What little passive dilation and contraction there can be seen in normal breathing is apparent only in the back part of the throat and is confined to a very narrow area of it because of the thick muscles of the hyoid and buccal floor. As the disadvantage of a thin walled, easily inflated and deflated buccal cavity is thus obviated, the buccal floor does not perform any movement during normal respiration. During laboured respiration, however, the buccal floor and tongue being elevated makes the expired air go completely out of the body, while their being depressed during the expansion of the thorax, facilitates the sucking in of fresh air.

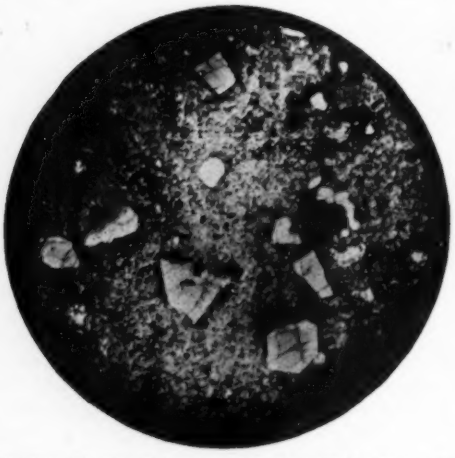
Letters to the Editor.

The Panjal Trap.

THE volcanic origin of the Panjal Trap of Kashmir was first established by the researches of Lyddeker and McMahon in 1883.[1] In his revision of the geology of Kashmir C. S. Middlemiss briefly referred to the Trap as 'genuine old basic lava flows'[2]. The microscopic characters have been described in some detail by D. N. Wadia. According to him 'the lava is a basic variety of augite-andesite'[3].

The most easily accessible and prominent outcrops of the Trap occur in the neighbourhood of Srinagar where they form the high peak of Takht-i-Suleiman and the precipitous scarp at the back of the Mogal Gardens. It is easily seen along the road leading from Srinagar to Anantnag up to a distance of 5½ miles where the Jhelum comes close to the hill. Here the trap is extensively quarried as a building stone. During a recent visit to Srinagar the authors observed that the rock was often of a very light colour and gave low values of specific gravity common to rhyolites and trachytes. At many localities clear phenocrysts of quartz could be seen in hand-specimens, especially with the aid of a lens.

The accompanying figure is a micro-photograph of a specimen taken from the quarry at Panthachuk, between the fifth and the sixth milestone, south-east of Srinagar. It shows euhedral to sub-hedral phenocrysts of quartz which have often suffered corrosion in the magma. These crystals also show original fine cracks which appear as white lines in reflected light. Phenocrysts of simple-twinned felspar are present and are turbid due to kaolinisation. The groundmass is micro- to crypto-crystalline and is of a felsitic character. Traces of a chloritic mineral and iron ore are present. In hand-specimens the rock is compact and has a grey colour with minute white and black spots of felspar and chlorite respectively scattered sparingly through the mass. Small phenocrysts of quartz are also visible under a lens. Its specific gravity is 2·63. A partial chemical analysis carried out by the usual method gave 78·89 per cent. of silica. The rock is clearly a quartz-felsite or rhyolite.



Rhyolite, Panthachuk, near Srinagar, Kashmir. × 20.

The general description of the Panjal Trap given by D. N. Wadia[4] applies to the rocks of this region except that granular augite is not seen as an essential constituent and the lavas often show phenocrysts of quartz. Pitchstone of a dark colour is not uncommon and shows a superficial resemblance to basalt. It is interesting to find that at least some of the lava-flows of the Panjal Trap are definitely rhyolites and not augite-andesites, and it is doubtful whether basic or sub-basic lavas occur in any quantity in the neighbourhood of Srinagar. Detailed study of the lavas of this formation round the Kashmir valley is being carried out by the second author of this article.

K. K. MATHUR.
S. N. WAKHALOO.

Geological Laboratory,
Benares Hindu University.
September 1, 1933.

[1] *Mem. G. S. I.*, **22**, p. 218.
[2] *Rec. G. S. I.*, **40**, Pt. 3, p. 235, 1910.
[3] D. N. Wadia, *Geology of India*, p. 360, 1926.
[4] *Op. cit.*

On the Incoherence of Fluorescent Radiation.

ACCORDING to the generally accepted ideas regarding the excitation of fluorescence by light waves, we should expect the fluorescent radiations starting from neighbouring molecules in the medium to be incoherent in

phase. The following experiment demonstrating the incoherence may be of interest. The principle of the experiment, originally due to Wood, is as follows. A rectangular glass cell containing a solution of fluorescein, was placed at some distance in front of the slit of a spectrograph. The light from a distant small mercury arc, after passing through a condensing lens and the fluorescent solution, came to focus on the slit of the spectrograph. A blue violet filter placed before the arc served to cut out all the radiations in the incident light, of longer wave-length than $\lambda 4358$.

Since the directly transmitted mercury radiations come to a sharp focus on the slit of the spectrograph, they will give rise to *very short* spectral lines on the photographic plate. If the fluorescent radiations from adjacent molecules were coherent in phase, these fluorescent radiations also would come to focus on the slit of the spectrograph, and give rise to a continuous spectrum having, like the spectrum of the directly transmitted light, very little extension parallel to the length of the slit. If on the other hand, the radiations are incoherent, the fluorescent band will widen considerably along the length of the slit. The accompanying spectrogram shows very clearly that the latter is the case.

The experiment was repeated with incident linearly polarised light, and the two principal vibrations of the partially polarised fluorescent radiations in the forward direction (parallel and perpendicular respectively to the vibrations in the incident light) were separately found to be also incoherent. Further with incident circularly polarised light the fluorescent radiations in the forward direction were found to be unpolarised.

Physics Laboratory, S. M. MITRA.
Dacca University,
September 5, 1933.

Seasonal Variations (Sexual Cycle) in the Testis of *Rana tigrina*.

BOTH lower and higher vertebrates offer a fruitful field for research regarding (1) seasonal variations in their organs of reproduction, and (2) an interesting line of investigation with a view to finding out whether the periodic activity of their gonads could, in any way, be correlated with the hormonic activities of their ductless glands. Oslund[1] has published a useful summary of the work done so far as the year 1925. Since then Bissonnette[2] has published a series of papers on the sexual cycle in the starling and Blount[3] has investigated the seasonal cycle of the interstitial cells in the testis of the horned toad. The difficulty of obtaining specimens of the animal under investigation throughout all the months of the year in other parts of the world may partly explain the paucity of papers on this subject. In this country Asana[4] has been working on the sexual cycle of some Indian lizards.

Frogs have been captured from one and the same locality in the vicinity of Gujarat College, Ahmedabad, at an interval of 8 to 10 days throughout the year. Observations were made and the gonads fixed from five to ten animals every time they were dissected. Adults of almost uniform size were selected.

From the latter half of October and throughout November, December, January and February externally the testes maintain their minimum size, their average volume being round about 4 c.mm. The average length and diameter of the testis during those months were ·4 cm. and ·115 cm.

[1] Oslund, R. M., "Seasonal modifications in testis of vertebrates. 1928," *Quart. Rev. of Biol.*, **111**, 254-270.

[2] Bissonnette, T. H., "Studies in the sexual cycle in birds. I. Sexual maturity, its modification and possible control in the European starling, 1930," *Am. Jour. Anat.*, **45**, 289-306.

Bissonnette and Chapnic, M. H., "Studies on the sexual cycle in birds. II. The normal progressive changes in the testes from November to May in the European starling, 1930," *Ibid.*, **45**, 307-343.

Bissonnette, T. H., "Studies on the sexual cycle in birds. III. The normal regressive changes in the testis of the European starling from May to November, 1930," *Ibid.*, **46**, 477-497.

[3] Blount, R. F., "Seasonal cycles of the interstitial cells in the testis of the horned toad, 1929," *Jour. Morph. and Physiol.*, **48**, 317-343.

[4] Asana, J. J., "Studies on the sexual cycle of some Indian lizards," *Proc. Nineteenth Indian Sci. Congress*, 1932.

respectively. Their microscopic examination reveals no spermatozoa internally, and in the testes the tubules are almost uniform in shape but small in size. Interstitial cells are very small and few in number. Thus the male gonads seem to be dormant as far as sexual activity is concerned during this part of the year.

From about the first week of March testes begin to increase in length and diameter, the changes being very gradual and the rate of increase very slow for about 20 days. Thereafter the male gonads increase in size at a very rapid rate throughout April and the first three weeks of May attaining their maximum growth during the last week of July, the average maximum volume being 147 c.mm. which is about 37 times greater than the average minimum volume. These external macroscopic changes seem to be correlated with the internal activity of the gonads leading to the production of mature spermatozoa. The tubules grow in size but lose their uniform shape. The interstitial cells correspondingly grow enormously both in size and number.

The regressive changes, the decline in the activity of the gonads, seem to be rather abruptly heralded; and before the end of August testes have decreased in size to a remarkable extent, the average volume being 15 c.mm. Through the whole of September and the first half of October there is a slow gradual decline leading to the attainment of the minimum size with which the cycle started.

Detailed observations including the study of the chromosomes will be published shortly.

J. J. ASANA.
R. J. KHARADI.

Gujarat College,
Ahmedabad,
September 1933.

Lint Color in Asiatic Cottons.

IN a review of all the existent literature on the mode of inheritance of lint color of cotton, Ware[1] has shown that in all intervarietal crosses in the New World cottons, expression of lint color can be explained by monofactorial hypothesis while in the interspecific crosses, the segregation for pigmentation is not clear cut and simple. The only references with regard to the behaviour of this character in the Asiatic cottons are by Fletcher[2] and Kottur.[3] The former just mentions that color is dominant over white, while the observations made by the latter on the interspecific cross between *G. herbaceum* and *G. neglectum* have pointed out that the splitting is nearer to 1 : 2 : 1 ratio than any other. But studies made by us at the Cotton Breeding Station, Coimbatore, on the progenies of the interspecific crosses between *G. obtusifolium*, *G. indicum* and *G. herbaceum* gave the interesting ratios of 9 : 6 : 1, 9 : 3 : 4, and 9 : 7 in the F_2 and F_3 generations. These lead us to formulate that the lint color in these cottons is governed by three pairs of factors. This assumption fits in with all the ratios obtained so far. A basic gene X seems to be essential for color production but its presence alone does not induce any manifestation of pigmentation unless it is in conjunction with either of factors K_1 and K_2. The three broad color groupings observed in these cottons, *viz.*, brown, cream and white, thus seem to be the result of interactions between factors X, K_1 and K_2. When all the three are present, the lint is colored brown, while a genetical constitution of either XK_1 or XK_2 results in cream coloration. The absence of both the factors K_1 and K_2 or the basal factor X appears to be responsible for white color. Minute shades of differences are also noted among these phenotypes. Further work is under way to test if they are produced by modifying factors and if the results of all possible crosses will be in consonance with the above assumption.

V. R. AYYAR.
R. B. IYER.

Agricultural College and
Research Institute,
Coimbatore,
September 18, 1933.

[1] *Journal of the American Society of Agronomy*, **24**, 553.

[2] *Journal of Agricultural Science*, **2**, 282.

[3] Imperial Department, *Agricultural Memoirs*, Botanical Series, **12**, 125.

A New Method for the Separation of the Two Components of Amylase.

IN recent years, several methods,[1-5] some very elaborate, have been proposed for the separation of the saccharogenic and the dextrinogenic components of malt amylase.

The present note relates to a simple method of separating the two components.

The new method consists in bringing about a preferential sedimentation in a centrifugal field in presence of alcohol. Malt extract was centrifuged for 20 minutes at 6,000 revolutions per minute in presence of 50 per cent. alcohol. The centrifuge tube was taken out and the centrifugate analysed for the presence of the two components. The activity of the saccharifying component was not impaired but on the other hand, the dextrinogenic component was reduced by about 47 per cent. The results of a typical experiment are given in table I.

TABLE I.

Control Experiment			Centrifugal Sedimentation	
Time in minutes	Activity of the saccharogenic component in mg. of maltose	Activity of the dextrinogenic component by coloration with iodine	Activity of the saccharogenic component in mg. of maltose	Activity of the dextrinogenic component by coloration with iodine
10	70.2	Blue	73.4	Blue
20	..	Violet	..	Blue
30	104.4	Red	106.0	Blue
45	..	Yellow	..	Violet
60	117.0	..	118.2	Violet
85	..	..	..	Yellow

The concentration of the enzyme, the P_H of the medium and the duration of the experiment are the main factors which determine the successful operation of this method. The optimum conditions for the complete separation of the two components are being investigated.

K. VENKATA GIRI.

Department of Biochemistry,
Indian Institute of Science,
Bangalore,
September 20, 1933.

[1] Ohlsson, *Compt. rend. trav. Labr. Carlsberg.*, **16**, No. 7, pp. 1-68, 1926.

[2] Narayanamurti and Norris, *Jour. Indian Inst. Sci.*, **11A**, 134, 1928.

[3] Venkata Giri and Subrahmanyan, *Jour. Indian Inst. Sci.*, **15A**, 107, 1933.

[4] Hamberg, *Biochem. Zeit.*, **258**, 134, 1933.

[5] Keshava Iyengar, *et al.*, *Curr. Sci.*, **1**, 238, 1932-33.

The Homoxyleæ and the Ancestry of Angiosperms.

THE homoxylous genera of angiosperms, namely, *Drimys*, *Zygogynum*, *Trochodendron* and *Tetracentron*, belong to the primitive group Magnoliales of Hutchinson. The gymnospermic vessel-less character of the wood of these primitive dicotyledons is of considerable interest and may be of theoretical importance. A fairly large scattered literature is available on the wood anatomy of these genera, and various botanists have discussed the theoretical bearings of the facts, but a comparative study of all the four genera and an attempt to distinguish them on the wood structure alone has not yet been undertaken. This object has now been achieved to a considerable degree and the resemblances between certain related fossil woods and these primitive genera of dicotyledons have been elucidated in a fully illustrated paper which is now in the press.[1]

The author has also reviewed the more important literature extending over a period of nearly a hundred years, dealing with the anatomy of homoxylous angiosperms and some related fossils. The important observations on the wood anatomy recorded by Goeppert, Groppler, Harms, Solereder, Van Tieghem, Bailey and Sinnott and others have been confirmed in the main points; in addition, the anatomy of the genera *Tetracentron* and *Zygogynum*, about which not much was known before, has been described and illustrated on the basis of the material kindly supplied to Prof. Sahni, by Professors Harms (Berlin) and Record Yale respectively.

The modern homoxylous angiosperms can be conveniently divided into two groups which are rather sharply defined both structurally and geographically.[2]

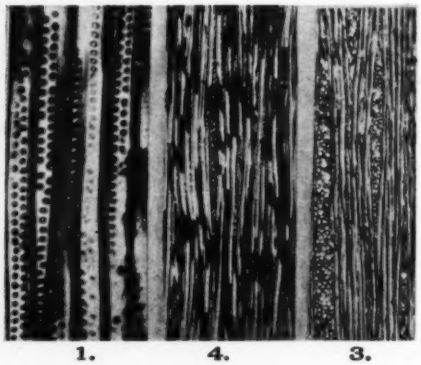
1. The *Drimys* group, comprising the two genera *Drimys* and *Zygogynum* and having several species distributed in the Australasian and American regions. These genera are essentially similar in their wood structure: growth-rings either absent or very faintly marked; medullary rays scarcely or not at all enlarged at the junction of the growth-rings; ray cells more or less uniformly pitted on their horizontal and tangential

[1] Expected to be published in the current volume of the *Journal of the Indian Botanical Society*.

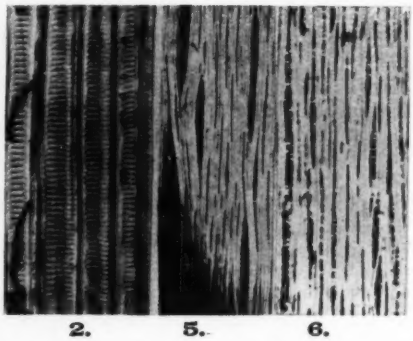
[2] See also Sahni, *Proceedings of the Indian Science Congress*, Patna, 1933.

walls. The usual pitting in the spring wood, both on the radial and tangential walls, is of the multiseriate type (Fig. 1).

2. The *Trochodendron* group, with *Tetracentron* and *Trochodendron*, both monotypic eastern genera confined to China and Japan respectively. Growth-rings well marked, with strongly developed autumn wood and medullary rays distinctly enlarged at the junction of the growth-rings. The usual pitting in the spring wood both on the radial and tangential walls is of the scalariform type (Fig. 2).



1. 4. 3.



2. 5. 6.

1. *Zygogynum* sp. Rad. sec. ×70.
2. *Trochodendron aralioides.* Rad. sec. ×70.
3. *Zygogynum* sp. Tang. sec. ×30.
4. *Drimys* sp. Tang. sec. ×30.
5. *Trochodendron aralioides.* Tang. sec. ×30.
6. *Tetracentron sinense.* Tang. sec. ×30.

All the four genera can also be distinguished by the shape of the medullary ray cells as seen in tangential sections of the wood. Thus: in the *Drimys* group, *Zygogynum* has its multiseriate rays somewhat broader than *Drimys* and the rays consist of large roundish or sometimes angular cells (Fig. 3), while in *Drimys* the shape of the central cells is drawn out into long ovals (Fig. 4). Similarly *Trochodendron* can be distinguished from *Tetracentron* by the fact that the multiseriate rays are broader (6-7 seriate) and the central cells are perfectly round and small (Fig. 5), whereas in *Tetracentron* (Fig. 6) the rays are less broad (2-3 seriate) and made up of long oval cells.

Such a combination of characters has not so far been found in any living angiosperm woods except the few types reviewed in the present paper; among fossil angiosperms the only comparable types are *Homoxylon rajmahalense* Sahni[3] and *Tetracentronites Hartzi* Mathiesen.[4] My sincere thanks are due to Professor Mathiesen who kindly sent a piece from the type specimen, thin sections of which have been examined by me. This early Tertiary fossil from East Greenland very closely resembles the living homoxylous angiosperms, specially the *Trochodendron* group. It is vessel-less and in radial section typical scalariform pitting with transitional stages is seen as described in *Trochodendron* and *Tetracentron*. My thanks are also due to the authorities of the Geological Survey of India who so kindly sent me the type sections of *Homoxylon*. It is an interesting fact that among gymnosperms such a combination of characters has only been recorded in a few Cycadeoids.[5]

The author has briefly discussed in his full paper the theoretical importance of these genera as far as speculated in the light of recent discoveries. He concludes that the Magnoliales might have either arisen from a group of fossil angiosperms contemporary with the Caytoniales or directly from some mesozoic Pteridosperms which may, as the recent work of Hamshaw Thomas suggests, be the ancestors of the modern flowering plants.[6]

If the age of *Homoxylon rajmahalense* Sahni, a fossil angiospermous wood devoid of vessels is proved to be definitely Jurassic in the

[3] Sahni, 1932, "*Homoxylon rajmahalense* gen, et sp. nov." *Memoirs G. S. I., Pal. Ind.*, **20**, Memoir No. 2.

[4] Mathiesen, 1932, "Notes on some fossil plants from East Greenland." *Meddelelser om Groenland.* Bd. **85.** Nr. 4, pp. 1-62.

[5] Wieland, 1916, *American Fossil Cycads*, Vol. II, pl. 35, figs. 4, 5; pl. 36, figs. 2, 3.

[6] H. H. Thomas, 1933, *Phil. Trans. Roy. Soc.*, London,....., 1931; *Ann. of Bot.*, **45**, 647-672.

future, it would indicate a parallel development of the Magnoliales and the Bennettitales, rather than a derivation of the former from the latter. The group Bennettitales is perhaps best regarded as a blindly ending line which may have gradually died out because real angiospermy could not be attained in that group.

In the end I must express my gratitude to Professor B. Sahni at whose suggestion this investigation was undertaken and who placed at my disposal all the material of living as well as extinct homoxylous woods, including some sections prepared by himself and Mr. B. P. Srivastava, M.Sc.

K. M. GUPTA.

Department of Botany,
University of Lucknow,
September 21, 1933.

Female Gametophyte of *Argemone mexicana* Linn.

IN a communication to the September issue of this Journal, Messrs. Bose and Banerji have criticised some of the work done by the writer on megaspore-formation and embryo-sac of *Argemone mexicana* with these remarks: "His account differs in certain fundamental points from our observations." A careful perusal of their communication, however, shows to me no such points.

The note deals with three main points, the primary archesporium megaspore-tetrad and comparative size of the antipodals and the egg apparatus. I had not seen the first, but from the arrangement of the cells at the tetrad stage of the megaspores, it was concluded that there is most probably a single hypodermal archesporial cell. Bose and Banerji find this presumption to be true. The megaspore-tetrad, I had studied only from one ovary and had found it to be T-shaped. They find not only this arrangement, but the linear one also; the latter is more frequent. It is not the case that they do not find the T-shaped arrangement. What they can very well study now is whether these different arrangements are confined to different flowers or can both arrangements be seen inside the same gynæcium. My observation leads to the first conclusion, but it may be exceptional and not the general rule. The comparative size of the antipodals and the egg-apparatus was studied by me when a good deal of endosperm had been formed. At this stage the antipodals were formed to be 8 to 10 times bigger than the egg. According to the estimates of Bose and Banerji themselves the egg at this stage is about 22μ long and the antipodals 154μ. So there is no great difference between the two accounts, although I found the antipodals to be as big as 200μ or a little more even. I had myself suggested the possibility of the antipodals being much smaller at an earlier stage. This Bose and Banerji really find to be true.

On the whole, what appears to me is that having been working on the subject for a very much longer time and on a much larger amount of material (compared with the two ovaries that I had studied), they have been able to get several more facts—quite a natural thing; and there are no fundamental differences between their observations and mine own.

A. C. JOSHI.

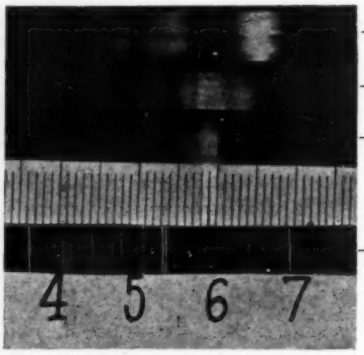
Department of Botany,
Benares Hindu University,
Benares,
October 1, 1933.

Oil-Soluble Vitamins in Some Pulses and Fishes of Bengal.

IN the last (September) issue of the *Current Science* we communicated certain facts regarding the presence of Oil-Soluble Vitamin A in some pulses and fishes of Bengal. The accompanying spectrographs are typical of many more which we have been able to obtain. The difficulties of recording successfully the absorption bands at the right moment are many. A reference may be made to the very valuable paper on "Specificity in Tests for Vitamin A"[1] in which some spectrographs are given obtained with Halibut Oil and $SbCl_3$ reagent. In our spectrographs presented here, just below the wavelength scale is placed Cadmium spark spectral lines. Just above the scale is the absorption spectrum of *Cicer arietinum Oil* and $SbCl_3$ reagent. We have examined two varieties of *Cicer arietinum*—(1) Kabuli and (2) Common—and both gave similar spectra. Above this is an absorption spectrum obtained with a sample of *Cod liver Oil* of approved quality. The uppermost one really consists of two halves—the upper half was taken last and given a longer

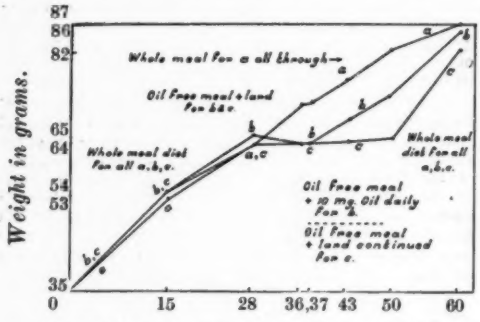
[1] Heilbron, Gillam and Morton, "Specificity in Tests for Vitamin A," *Biochemical Journal*, **25**, No. 4, 1346–66, 1931.

exposure while the lower half was taken just half a second earlier than the last with a shorter exposure; these last ones are the absorption spectra of Hilsha Fish Roe Oil (*Clupea ilisha*).



H.r.—Hilsha roe oil.
C.l.—Cod liver oil.
K.c.—Kabuli chhola oil.
C.s.—Cadmium spark.

The final arbiter is the physiological method. The accompanying curves represent the results obtained with a particular litter of rats. The diet in this case was prepared in the Bose Institute Laboratories and consisted of Kabuli Chhola Meal (*Cicer arietinum*) and made oil free as required. It may be mentioned that similar results have been obtained with B. D. House products. Several litters of rats have given similar (more or less) results. Fat-free diet producing Xerophthalmia and unkempt hair, particularly on the back parts above the hind legs, are soon noticed and have been cured by the application of daily doses of *Cicer arietinum* Oil (and compared side by side with Cod liver Oil and Hilsha Fish Oil). A general weakening of the legs, particularly hind legs, and an increased thirst for water is also observed in rats kept on fat-free diet.



Days after which weights were recorded.

In the particular set of curves which represent the results, all the young rats *a*, *b*, *c*, on the day they were put on whole meal diet, weighed each 35 grams. On the 15th day after the starting *a*, which by the way was kept as control all through on whole meal diet, weighed 53 grams; both *b*, and *c* each weighed 54 grams. From this point *b* and *c* were kept on fat-free (oil free) *Cicer arietinum* diet with lard to replace the oil. From the 28th day the increase in weight stopped and the weight became steady at 64 grams. From the 37th day *b* was given a daily dose of *Cicer arietinum* oil instead of lard and began to show gain in weight, while *c*, which was still kept on oil-free+lard diet showed no change. This was continued till the 50th day, when all the three sets were again given whole meal diet as at the commencement of the observations. Ten days after, on the 60th day, there was gain in weight in all the three and remarkable recovery in *c*.

Further details will be published in due course in the *Transactions of the Bose Research Institute*.

H. N. BANERJEE,
N. C. NAG.

Calcutta,
October 5, 1933.

Erratum.

Current Science, Vol. II, No. 3, September 1933, page 95, left-hand column, lines 32, 33, 35 and 37—

for "μ" *read* "mμ".

Recent Researches on the Ætiology of Goitre.*

THE past few years have witnessed considerable progress in the study of this highly important problem. They have shown more vividly than at any earlier period that the causes of goitre are multiple and their effects manifold. Some of the causes are now definitely known. They are essentially nutritional and hygienic. Their combination in various ways may give rise in different persons and different localities to diverse types of goitre of both sporadic and endemic kinds. True endemic goitre with its sequelæ of congenital goitre and cretinism would appear to be due to a summation of these causes and to-day it can be said with greater assurance than ever before that the disease can be prevented by attention to fundamental principles of nutrition and of personal and social hygiene.

It is now well established that the physiological attributes of the thyroid gland are similar in all the higher animals: observations made on one species are therefore applicable to others, due regard being paid to different conditions of life, food, metabolism and such like. Since smaller animals are more convenient to work with than bigger ones, the more recent investigations, particularly those of McCarrison and his co-workers at Coonoor, were carried out chiefly with pigeons, rats, guinea-pigs, rabbits and monkeys. They related mainly to (*a*) the biometric study of the normal thyroid gland in different species of animals, (*b*) statistical study of experimental data with special reference to the effect of diet on thyroid gland, (*c*) experimental production of lymph-adenoid goitre, (*d*) study of goitrogenic agents associated with food materials and anti-goitrogenic substances other than iodine, and (*e*) the effect of insanitary condition on the thyroid gland and the interactions of this condition with faulty food in the causation of goitre.

The weight of the thyroid gland in any animal depends on a number of factors such as locality, sex, sexual activity, season, individual idiosyncrasy, sanitary condition and diet. Of these, diet is the most important, variability being at its lowest in animals on perfectly constituted diet and at the highest in those receiving diet of diverse character or possessing goitrogenic properties. The weight of the thyroid gland is not by itself a useful indication: the observations of McCarrison and Madhava have shown that the ratio ('r') of the organ weight to the body weight is a more definite index of the conditions of the thyroid at any particular stage. If the mean values of 'r' corresponding to selected intervals of body weight are plotted out, there may be observed a gradual increase of 'r' values in the earlier stages of growth culminating in the attainment of a maximum point after which the curve turns round into a subsequent stage of progressive diminution of such values. The curve thus obtained is a highly characteristic one which the authors have, in picturesque phraseology, designated "The Life-line of the Thyroid Gland". The height, the evenness (or slope) of movement and even the shape of the life-line is affected by a variety of factors, so that by following the course of the curve it is possible to determine the response of the thyroid to any particular treatment.

Goitre surveys conducted by the method of visual examination are inadequate: not only the breadth of the neck but also the development of the body must be taken into consideration. The apparent evidence of goitre in school-children is not a true criterion of the endemicity of the disease: in fact, many of the so-called childhood goitres do not represent the diseased condition of the thyroid gland at all, but the normal expression of the place of the organ in relation to the growth and development of the children concerned. If this fact be recognised, a considerable amount of confusion regarding the ætiology of endemic goitre would be removed.

The importance of diet in relation to goitre cannot be over-emphasized. It may, in fact, be stated as an axiom that the more perfect the diet, the more stable is the thyroid gland in point of size and the less likely is goitre to occur. In this connection it should be pointed out that excess of certain ingredients possessing anti-goitrogenic properties may lead to goitrous symptoms. Thus excess of whole milk is harmful, the fat thus taken disturbing the fat / iodine ratio which, in turn, affects the thyroid gland. Radiostelium (containing vitamins A and D) has a tendency to slightly increase the ratio of thyroid weight to body weight either when it formed the sole source of those vitamins or when added to diets ill-balanced with respect to calcium and phosphorus. A scorbutic diet (deficient in vitamin C) is also harmful. Deficiency of suitable protein or certain mineral salts or some enzymes and excess of carbohydrates would also appear to contribute their share to the general disorder of the thyroid gland. On the other hand, starvation causes marked reduction in both the weight and the size of the thyroid.

Lymph-adenoid goitre has now been produced under experimental conditions in albino rats. It has been observed in the case of rats fed on synthetic diets the main fault of which is one of vitamin-deficiency. This type of goitre can occur in spite of adequate ingestion of iodine. The ultimate causes of the origin of lymph-adenoid goitre in rats is still not fully understood, but there is definite evidence to show that a perfectly constituted diet affords complete protection against it.

The frequent association of goitre with limestone rocks and with drinking water rich in lime has long been known. Recent researches have shown that the action of lime is bound up with a relative deficiency of iodine and phosphates. Sometimes the reverse may also happen, excess of iodine combined with poor supply of calcium also leading to goitre in experimental animals. It would thus appear that the disturbance of calcium / iodine balance in either direction is an important factor in the genesis of goitre. Addition of phosphate is useful in reducing the adverse effects of excessive amounts of calcium, but cases are on record to show that there is need for balancing of diet by addition of milk even after the calcium/phosphorus imbalance has been corrected. There is also evidence to show that excess of calcium or

* Summary of report presented by Col. Sir R. McCarrison, K.C.I.E., M.D., D.Sc., F.R.C.P., to the Second International Conference on Goitre held at Berne during August 1933.

mineral imbalance may interact with vitamin and protein deficiency causing thyroid disorder.

Studies on the effect of iodine on thyroid tissue grown *in vitro* have shown that increasing dosages up to 25γ in 100 c.c. have a stimulating effect on both the growth and metabolism of the cells. Higher concentrations of iodine increase the rate of metabolism without favouring growth: in such cases the life of the cells is also correspondingly shortened. Those results afford conclusive proof to show that small doses of iodine have a direct, stimulative action on the thyroid gland.

Recent investigations have shown that association of goitre with low iodine content of soil is not invariable: nor could any correlation be observed between the iodine content of drinking water and the incidence of goitre. Furthermore, while a low content of iodine in food is one of the factors leading to goitre, yet addition of iodine to a well-constituted diet may not always prove beneficial. Though iodine is a powerful anti-goitrogenic agent, it is not always so potent in its action as thymol, manganese chloride or thyroxine. There is considerable evidence to show that though deficiency in iodine is one of the causes favouring particular types of goitre, it is not the essential cause of every form of that disease.

Following the observations of Clawson, Chesney and Webster and later, of Marine and his co-workers an extensive series of investigations were carried out by McCarrison and his associates on the causation of goitre by cabbage. The results have shown that although cabbage has a goitrogenic potency, yet its intensity is affected by various factors. It changes with season: its effect varies with individuals. The inconsistency is partly accounted for by the fact that cabbage also contains antigoitrogenic constituents, which are mostly present in the juice. The goitrogenic agent is insoluble in water but is extracted by ether and other solvents. It is heat-stable and is resistant to oxidation in the air. Certain food materials such as bran enhance the goitrogenic potency of cabbage, while others such as carrots, legumes and fresh green grass help to diminish it. Certain chemicals like sodium chloride and radiostelium enhance its action while others like iodine, thymol, manganese chloride or thyroxine either diminish or wholly counteract its effects. Addition of iodine to drinking water prevents the occurrence of cabbage goitre. The goitrogenic action of cabbage is not, however, due to deficiency of iodine in that vegetable. There is some evidence to suggest that the harmful constituents are of the nature of cyanogen compounds.

More recent researches have shown that several other substances are also goitrogenic in their properties. Thus, Marine and his collaborators have incriminated other members of the *Brassica* family and some *Cruciferæ* as goitrogenic food-materials. McCarrison and his co-workers found soya-bean, ground-nut (both defective in Vitamin C) and sorghum (*Andropogon*) to be also goitrogenic. Such food-materials do not, however, cause the disease unless they are taken in large quantities. If taken with a balanced diet, their effects are neutralised by other vitamin-bearing constituents. Thus, whole milk, carrots, fresh green grass and sprouted legumes are anti-goitrogenic in their properties. It has been suggested (Marine *et al*) that the anti-goitrogenic principle in certain food-materials is hexuronic acid: in view of the increasing evidence to suggest the identity of the latter with Vitamin C, it would appear that substances rich in that vitamin would be anti-goitrogenic in their properties.

Balanced food by itself is not a safeguard against goitre. The investigations of McCarrison and his co-workers have shown that insanitary conditions may also lead to the development of that disease in animals. There is no definite evidence to show whether any of the products formed as the result of the fermentation of the excretal materials and food remnants is by itself responsible for the effects observed. On the other hand, combination of neutral diet with the aqueous extract of fermented compost in insanitary cages led to nearly 60 per cent incidence of true goitre while the controls receiving the diet alone showed none, thereby indicating that the extract had a definite predisposing action. This suggestion was supported by histological examination of the sections of the glands which showed they were subject to degenerative changes corresponding to those observed in systematic infections and severe toxæmias. These observations together with those of other workers, particularly those of Turcu, Womack, Cole and Heidmann, Anderson and Twort would show that a variety of substances, both chemical and microbic, are capable of giving rise to goitrous changes in the thyroid gland.

It may be concluded from the above that apart from influences such as hereditary predisposition, individual idiosyncrasy, puberty and pregnancy, there are some evident and conjunct cases of goitre:— (1) Increased demand on the part of the organism for the products of the thyroid gland, such as may be occasioned by conditions which depress tissue-oxidation or by excess of certain substances (fats, lime and the goitrogenic agent in some vegetables) in the food. (2) Faulty nutrition of the gland, with depreciation in the functional efficiency of glandular epithelium and increased susceptibility to the action of toxic and microbic agencies: such as may be occasioned by deficiency of suitable protein and certain vitamins in the diet. (3) Action of toxic substances on the gland, such as those of some chemical poisons, toxins of intestinal and other bacteria and the goitrogenic products resulting from the fermentation of excretal materials and remnants of food. (4) Lack or insufficiency of certain food-essentials such as vitamins, hexuronic (or ascorbic) acid, iodine, phosphates and certain unidentified anti-goitrogenic substances associated with well-balanced food.

The stage of theory in regard to the ætiology of endemic goitre is now passed. There is no doubt a great deal more is to be known, but the proven facts should encourage the workers to proceed further ahead with the accumulation of fresh facts, so that, before long, the world may know a great deal more about the remoter mysteries which still surround the ætiology of the protein malady, which we call 'Goitre'.

The British Association—Leicester Meeting, 1933.

The Presidential Address—Some Chemical Aspects of Life.

SIR FREDERICK HOPKINS' thoughtful address relates to the chemical processes that determine the mechanism of life.

'Though speculations concerning the origin of life have given intellectual pleasure to many, all that we know about it is that we know nothing.' We do, however, know a few fundamental facts concerning that process. One such is the arrest of the steady increase of entropy displayed by all the rest of the Universe. That the living organism checks the degradation of energy in Nature is primarily a biological concept. Related to it and of equal importance is the concept of organisation.

'It is almost impossible to avoid thinking and talking of life in this abstract way, but we perceive it, of course, only as manifested in organised material systems, and it is in them we must seek the mechanisms which arrest the fall of energy. Evolution has established division of labour here. From far back the wonderfully efficient functioning of structures containing chlorophyll has, as everyone knows, provided the trap which arrests and transforms radiant energy fated otherwise to degrade—and so provides power for nearly the whole living world. It is impossible to believe, however, that such a complex mechanism was associated with life's earliest stages. Existing organisms illustrate what was perhaps an earlier method. The so-called autotrophic bacteria obtain energy for growth by the catalysed oxidation of materials belonging wholly to the inorganic world; such as sulphur, iron or ammonia, and even free hydrogen. These organisms dispense with solar energy, but they have lost in the evolutionary race because their method lacks economy. Other existing organisms, certain purple bacteria, seem to have taken a step towards greater economy, without reaching that of the green cell. They dispense with free oxygen and yet obtain energy from the inorganic world. They control a process in which carbon dioxide is reduced and hydrogen sulphide simultaneously oxidised. The molecules of the former are activated by solar energy which their pigmentary equipment enables these organisms to arrest.'

'Are we to believe that life still exists in association with systems that are much more simply organised than any bacterial cell? The very minute filter-passing viruses which, owing to their causal relations with disease, are now the subject of intense study, awaken deep curiosity with respect to this question. We cannot yet claim to know whether or not they are living organisms. In some sense they grow and multiply, but, so far as we yet know with certainty, only when inhabitants of living cells. If they are nevertheless living, this would suggest that they have no independent power of obtaining energy and so cannot represent the earliest forms in which life appeared. At present, however, judgment on their biological significance must be suspended. The fullest understanding of all the methods by which energy may be acquired for life's processes is much to be desired.'

The past one hundred years have witnessed considerable amount of controversy between the extreme physico-chemical and the vitalistic concept of life. We are yet far from knowing the ultimate truth but it would form a useful basis for discussion if we recognise that 'at a different and recognisable level of its dynamic organisation, an organism can be logically described in physico-chemical terms alone.'

Researches conducted during the present century have brought about marked changes in our outlook in various directions. To take an instance one may cite the respiration of the muscle and the attendant transformations. To-day we know that the previous 'conception of continuous building up and break-down of the muscle substance, as a whole, has but a small element of truth. The colloidal muscle structure is, so to speak, an apparatus relatively stable even as a whole when metabolism is normal, and in essential parts very stable.' The related chemical processes and energy transformations have also been studied with remarkable thoroughness. They show, among other things, that the conditions are, to a large extent, similar to those occurring in the yeast cell, thus providing a striking illustration of the unity of life.

The living cell would be a static system were it not for the fact that it is equipped with a variety of enzymes which assist in bringing about the required transformations. Each enzyme is specific in its action. The combined activities of the different enzymes present in a cell determine its ultimate physiological behaviour and thus distinguish it from other forms of life.

When the multitude of chemical events in a living cell are well co-ordinated, then the latter displays its sensitiveness to molecules of the special nature which enter from without. A striking instance of this is provided by the response of the heart to the impulse of the vagus nerve. When the heart receives vagus impulses, the substance, acetyl choline, is liberated within that organ. It is acetyl choline that ultimately produces the characteristic effect as may be demonstrated by direct injection of graded doses of that chemical.

Similar and, perhaps, even more profound are the effects of the chemicals which are formed in specialised organs of the animal body and which maintain harmonious growth and control the rate of metabolism. Some of these chemicals such as adrenalin, thyroxin, secretin and insulin are already well known. More recently, considerable light has been thrown on the nature and mode of action of œstrin, the harmone which, in a most remarkable manner, co-ordinates the phenomena of sex.

In the group of substances which control and co-ordinate events in the animal body by virtue of specific molecular structure we must also include the vitamins. As distinct from the harmones which are formed in the animal body, the vitamins have to be supplied in the diet. The distinction between the two is not, however, so great as it may appear because some animals can synthesise the requisite vitamins, in which case the latter become harmones.

The recent output of scientific work in the field of vitamins is prodigious, nearly one thousand papers on the subject appearing in a single year. 'Some aspects of its development have been interesting enough. The familiar circumstance that attention was drawn to the existence of one vitamin (B1 so called) because populations in the East took to eating milled rice instead of the whole grain; the gradual growth of evidence links the physiological activities of another vitamin (D) with the influence of solar radiation on the body, and has shown that they are thus related, because rays of definite wave-length convert an inactive precursor into the active vitamin, alike when acting on foodstuffs or on the surface of the living body; the fact again that the recent isolation of vitamin C, and the accumulation of evidence for its nature started from the observation that the cortex of the adrenal gland displayed strongly reducing properties; or yet again the proof that a yellow pigment widely distributed among plants, while not the vitamin itself, can be converted within the body into vitamin A; these and other aspects of vitamin studies will stand out as interesting chapters in the story of scientific investigation.'

In recent years increasing evidence has also been obtained to show that many micro-organisms and higher plants require the supply of vitamin-like substances for the promotion of growth. The 'auxines', as they are called, are essentially of the nature of harmones.

Our knowledge of the molecular structure of vitamins and harmones is growing fast: the relation between the individuals and the manner of their action on animal tissue is also fast coming to light. As an instance of this, one may cite the following observations that relate to some well-known substances.—"The vitamin, which in current usage is labelled A, is essential for the general growth of an animal. Recent research has provided much information as to its chemical nature. Its molecule is built up of units which possess what is known to chemists as the isoprene structure. These are condensed in a long carbon chain which is attached to a ring structure of a specific kind. Such a constitution relates it to other biological compounds, in particular to certain vegetable pigments, one of which a carotene, so called, is the substance which I have mentioned as being convertible into the vitamin. For the display of an influence upon growth, however, the exact details of the vitamin's proper structure must be established. Now turning to vitamin D, of which the activity is more specialised, controlling as it does, the growth of bone in particular, we have learnt that the unit elements in its structure are again isoprene radicals: but instead of forming a long chain as in vitamin A, they are united into a system of condensed rings. Similar rings form the basal component of the molecules of sterols, substances which are normal constituents of nearly every living cell. It is one of these, inactive itself, which ultra-violet radiation converts into vitamin D. We know that, as stated, each of these vitamins stimulates growth in tissue cells. Next consider another case of growth stimulation, different because pathological in nature. As you are doubtless aware, it is well known that long contact with tar induces a cancerous growth of the skin. Very important researches have recently shown that particular constituents in the tar are alone concerned in producing this effect. It is being further demonstrated that the power to produce cancer is associated with a special type of molecular structure in these constituents. This structure, like that of the sterols, is one of the condensed rings, the essential difference being that (in chemical language) the sterol rings are hydrogenated, whereas those in the cancer-producing molecules are not. Hydrogenation indeed destroys the activity of the latter. Recall, however, the ovarian harmone œstrin. Now the molecular structure of œstrin has the essential ring structure of a sterol, but one of the constituent rings is not hydrogenated. In a sense therefore the chemical nature of œstrin links vitamin D with that of cancer-producing substances. Further, it is found that substances with pronounced cancer-producing powers may produce effects in the body like those of œstrin. It is difficult when faced with such relations not to wonder whether the metabolism of sterols which, when normal, can produce a substance stimulating physiological growth, may, in very special circumstances, be so perverted as to produce within living cells a substance stimulating pathological growth." Some of the links still require experimental support, but even the observations, so far made, are sufficiently conclusive to show that there is close relation between chemical structure and biological activity.

The relative importance of the physical sciences and biology in the study of the phenomena of life has been much debated, but it would suffice to say that, whatever be their limitations, the former are bound to profoundly affect biological conceptions. At the same time, it should be emphasised that pure biology, in all its concepts, has an important bearing on human welfare though, unfortunately, it has not lately been realised so well as it should be. This is partly due to the neglect of biology in our educational system and partly to the fact that physical sciences have, lately, had more brilliant exponents to the intelligent lay public than biology.

In recent years, much thought has been given to the possible misuse of the gifts of science to mankind. 'The command of nature has been put into man's hand before he knows how to command himself.' It should, at the same time, be admitted that the fault is with mankind and not with science. "War apart, the gifts of science and invention have done little to increase opportunities for the display of the more serious of man's irrational impulses. The worst they do perhaps is to give to clever and predatory souls that keep within the law, the whole world for their depredations, instead of a parish or a country as of yore."

There are two other great questions before mankind which require careful consideration. One is the paradox of poverty in the midst of plenty and the other, replacement of human labour by machinery. Applied science should take no blame for the former, but indeed claim credit unfairly lost. As for the latter, there would now appear to be greater fear arising from 'Money *versus* Man' rather than from 'Machinery *versus* Man'!

Considering the present march of events, there is great need to plan for the future. 'In such planning the trained scientific mind must

play its part. Its vision of the future may be very limited, but in respect of material progress and its probable consequences Science has at least better data for prophecy than other forms of knowledge.' 'Though statesmen may have wisdom adequate for the immediate and urgent problems with which it is their fate to deal, there should yet be a reservoir of synthesized and clarified knowledge on which they can draw. The technique which brings Governments in contact with scientific knowledge in particular, though greatly improved of late, is still imperfect. In any case the politician is perforce concerned with the present rather than the future.' 'When civilization is in danger and society in transition might there not be a House recruited from the best intellects in the country with functions similar (*mutatis mutandis*) to those of Bacon's fancy? A House devoid of politics, concerned rather with synthesising existing knowledge, with a sustained appraisement of the progress of knowledge, and continuous concern with its bearing upon social readjustments. It is not to be pictured as composed of scientific authorities alone. It would be rather an intellectual exchange where thought would go ahead of immediate problems!'

'If the political aspirations of the nations should grow sane, and the artificial economic problems of the world be solved, the combined and assured gifts of health, plenty, and leisure may prove to be the final justification of applied science. In a community advantaged by these each individual will be free to develop his own innate powers, and, becoming more of an individual, will be less moved by those herd instincts which are always the major danger to the world.'

Section A.—Mathematical and Physical Sciences.

THE Presidential Address to Section A of the Leicester Meeting of the British Association was delivered by Sir Gilbert T. Walker on Seasonal Weather and its prediction. After pointing out the importance of weather forecasts, he stressed the danger to the prestige of the science which might arise from over-confident forecasts based on insufficient data. He also deprecated the practice of ascribing periodicity to weather conditions on insecure evidence and trying to predict weather on the basis of such assumed periodicity. Passing next to his main theme, the lecturer explained what was meant by the correlation coefficient between two varying factors. The method of weather determination was then explained. Taking the variation over a period of years of the pressure, temperature and rainfall of a number of typical places whose variations show a positive or negative correlation coefficient approaching unity a mean graph or set of numbers is computed and taken to be characteristic of the region. Then the correlation coefficients between this mean variation and the variation of the weather conditions at any particular place are calculated. Wherever there is a large correlation coefficient between the variations say in winter and those in summer, there is opened up the possibility of predicting summer conditions from the winter oscillation. Sir Gilbert illustrated this process by means of a number of graphs showing the North Pacific Oscillation and its relation to the pressure, temperature and rainfall in the surrounding regions, and also the Southern Oscillation from December to February and the same from June to August with the correlation between them. The lecturer also pointed out the necessity of a careful discrimination in drawing conclusions from statistics and illustrated his remarks by means of a very effective example, in which a comparison of illiteracy at marriage with unemployment led to a high negative correlation coefficient, but the fallacy lay in not taking into account the trend of the total amount of trade at the same time. Sir Gilbert then quoted instances from actual practice where the above methods had led to important results as in the monsoon forecasts in India and weather predictions in Southern Rhodesia. He then described the methods used for seasonal forecasting in Sweden and Russia and referred to the researches carried out by Dr. Franz Baur at Frankfurt a.M. In conclusion, the lecturer again stressed the necessity for stringent tests of any suggested periodicity in weather and for caution in prediction and expressed the hope that the subject may draw more investigators to its study on account of its interest and importance.

Section B.—Chemistry.

IN his Presidential Address to Section B (Chemistry) of the British Association, Prof. R. Robinson has made a fascinating and extremely valuable survey of his brilliant researches on the anthocyanin pigments of plants, which in the course of a decade have revolutionised our knowledge of the subject. A prefatory account of some natural colouring matters and their synthetic analogues indicates the value of investigations on plant pigments from the point of view both of academic interest and of technical possibilities.

The pioneering work of Willstatter established the main features of the structure of the anthocyanins as saccharides, occasionally acylated, of the anthocyanidins. They exhibit amphoteric character, forming salts with both acids and bases. The constitution of the three fundamental anthocyanidins, pelargonidin, cyanidin and delphinidin, has been proved beyond doubt by degradation and many syntheses. Although one method of synthesis, the reduction of quercetin to cyanidin, offers a ready and attractive hypothesis of the biogenesis of the anthocyanin pigments, the experimental support for such a view will not bear scrutiny.

Peonidin, petunidin, malvidin and hirsutidin have been shown to be methyl ethers of two of the three fundamental types and all have been synthesised.

The greater number of the anthocyanins can be classified as (*a*) 3-monoglucosides and 3-monogalactosides, (*b*) 3-rhamnoglucosides and other 3-pentoseglycosides, (*c*) 3-biosides, (*d*) 3 : 5-diglucosides, and (*e*) acylated anthocyanins. Several of the types, notably pelargonin, cyanin, peonin, malvin and hirsutin, have been synthesised by ingenious modifications of the general schemes of pyrylium salt synthesis devised by Robinson in collaboration with Pratt and others.

(Mrs.) Robinson and Robinson have studied the behaviour of the anthocyanins as indicators and the causes of the variations of flower colour. The main factors affecting flower colours are: (1) the nature and concentration of the anthocyanins

and other coloured substances present; (2) the state of aggregation of the anthocyanin in solution, the *p*H of the cell-sap and the presence of protective colloids being some of the subsidiary factors affecting this; and (3) the presence or absence of co-pigments and, problematically, the effect of traces of iron and other complex forming metals.

The culmination of the work so far is the evolution of qualitative tests, dependent for example on oxidation, on colour variation in solutions of graded *p*H, and on distribution between immiscible solvents, which enable us to recognise the nature of an anthocyanin with speed and certainty.

Section C.—Geology.

IN his Presidential Address to the Geology Section of the recent (Leicester 1933) Meeting of the British Association for the Advancement of Science, Prof. W. G. Fearnsides deals with an intensive study of the structures in the coal fields of the Midland Province in England. In accordance with his strong conviction that structural geology is a science of measurement and that the real geology of an area is not fully known until it can be represented by a model true to scale. Prof. Fearnsides has chosen the Midland coalfield province, with a view to prepare such a model, if possible, based on known details of the geology of this area compiled from the records of nearly a thousand working mines within this province. From a detailed account of the stratigraphy and mode of accumulation of the local rocks and of the crustal movements which allowed their accumulation in the Midland carboniferous geosyncline Prof. Fearnsides has proved that the Midland Province is a structural unit of deposition and slowly developed as a coal measure geosynclinal basin which was averted before Permian time; and in general, it is now a synclinorium with a central lop-sided crumpled dome. The synclinals within the synclinorium "deepened intermittently, but progressively, as the geosynclinal filled; and though as a whole the province may occupy an early downfold in the foreland of the Hercynian Alpine chain, its leading fold lines are re-emphasised and rejuvenated structures which in origin are older."

Section D.—Zoology.

DR. GRAY gives an indication of the scope of his address by formulating three questions which, though historical, have to be asked now and then in reviewing the progress of the different branches of Zoology. What is our conception of the essential nature of the living organism? Do we believe that the activity of living matter and its potentiality for change can be expressed adequately in terms of physical units? Do we incline to the belief that living animals have been evolved from inanimate matter? These questions in one form or another have perplexed the mind of philosophers of antiquity who sought refuge in revealed religion and within recent times several theories have been propounded in answer to them. Of these theories, the mechanistic and vitalistic concepts of life have held the ground with varying fortunes.

According to the Mechanical Theory of Life, the biological phenomena are only complicated constellations of physical and chemical processes. It is true that the results that have been obtained by the application of physical and chemical methods as instruments of biological investigations, have greatly helped the understanding of the physical and chemical attributes of living matter and the elucidation of certain aspects of single physiological process, but obviously they can offer no adequate explanation of the equally fundamental facts such as adaptation, regulation, activity, autonomy, compensation and pathology which give to the organisms a unique position in contrast to the inorganic world. The mechanical theory of life as Dr. Gray has pointed out, received a fresh impetus by the synthesis of certain organic compounds and by the parallelism instituted between the processes of organic and terrestrial evolution, as though they involved the operation of similar forces. Among the Biologists there are notable advocates of the mechanical theory of life and "it is a curious but pertinent fact that the most far-reaching mechanistic views have been and are being put forward by biologists, the more cautious views or the vitalistic views are held by physicists and chemists." It is conceivable that at some remote time in the geological history of the World inanimate matter may have possibly been transmuted into living substance just as it is perfectly conceivable that "it is also possible for a stone to leap spontaneously from the surface of the earth." "These things are possible but are they probable?" Biological researches do not provide any evidence to support the spontaneous origin of living substance and attempts on the part of biologists to postulate the spontaneous origin of intermediate stage between the living and the inanimate world cannot be comprehended under the category of "laws" which relate to the body of verifiable natural events. If we can entertain a concept of "co-ordinated series of self-regulating and self-propagating chemical reactions" in the production of living from inanimate matter, then what is it that hinders a not dissimilar concept being entertained of a lump of iron, wood, rubber and glass acquiring a co-ordinated series of self-regulating reactions to be spontaneously converted into a motor car, running through a crowded traffic without encountering accidents by generating a series of self-propagating reactions, including stoppages at kerb fountains for re-fuelling and re-oiling? What makes the mechanical view of life unacceptable to most scientists is the fact that it is unsuitable for the very purpose for which it was introduced, *viz.*, the physico-chemical analysis of vital processes, and so far as is known there is no evidence "which suggests that within the physical world, a dynamic machine has spontaneously come into existence." It is true that matter in a living organism in certain aspects of its behaviour may be interpreted in terms of physical and chemical units, but its characteristics in its wholeness are fundamentally different from those of inanimate objects. The modern theories of development and the researches of experimental embryology tend to confirm the view that "the cell has an individuality of its own—which is free from the limitations of statistical laws."

The main attributes of living organisms are more vividly recognised by studies in embryology than those of general biology, *viz.*, Life is a system-property and an organism functions in its wholeness. Mechanism provides us with no understanding of these fundamental characteristics of

the organisation of organic processes among one another, of organic wholeness, of the problem of the origin of organic Teleology or of the historical character of organisms. Since the fundamental attribute of living organisms is their complicated organisation and their wholeness, the experimental investigations of the single part and single process based on the methods of physico-chemical analysis, cannot provide a complete and satisfactory explanation of the vital phenomena. This mode of investigation gives little information concerning co-ordination of parts and processes in the living organisms in their wholeness which cannot be compared with the reactions observed in test tubes.

The physiologist and the experimental embryologist have added considerably to our knowledge of the physical and chemical behaviour of parts of living substance or organisms, but our knowledge of the organs and organisms is something more in that they arise from a system unlike their own and possess potentiality of evolving into newer and more complicated forms. The investigations of the physical and chemical properties of parts of the living organisms may give us an explanation of the attributes and behaviour of the mechanical framework of such parts under induced conditions but that explanation must be hopelessly inadequate to give us a complete picture of "the intrinsic potentialities of living matter revealing as it does a co-ordination of events" for which there is no parallel in inanimate nature. In the first type of study we are free to use the instruments provided by the physical sciences, but in regard to the latter, organismic biology must build on her own foundations and not tend to merge in physics or chemistry.

Section E.—Geography.

IT is immaterial whether Geography is a synthetic new recruit to the ranks of science or is the mother of all sciences; its cultural value in any scheme of education is always profound and the presidential address of Lord Meston is a skilful and elaborate exposition of this theme. The intrinsic usefulness of the study of Geography from a broader standpoint becomes all the greater when it establishes contact with the other branches of knowledge closely related to it and in fact we are fast arriving at a stage when knowledge cannot be treated in isolated segments, but should be presented in its wholeness. Perhaps instead of subjects, topics will have to be adopted for study and the children are to be enabled through easy and gradual stages, to grasp the many aspects from which each topic can be viewed and understood and that all approaches to the study of a topic result in unfolding one and indivisible truth. If at the present moment, the subject-method is in the widest practice in the class rooms, it is because the teachers do not have that intimate and comprehensive acquaintance with different branches of science so as to enable them to deal with the general scientific topics from their different viewpoints and harmonise knowledge into an integral unity.

The greatest mistake that the old text-books of Geography made was to describe the solid earth as an immutable structure, the hills as everlasting, the races of mankind as static social groups and the soils, climate, commerce, and international relations treated more or less from a stereotyped standpoint. If Geography is a function of a number of sciences, it must keep pace with the progress of the latter and its content must include the fresh data contributed by Physics, Chemistry, Geology, Biology, Sociology, Economics, Archæology, Anthropology, Explorations, Politics and History. Pre-historic geography is not a mere study of the movements of land and sea, the distribution of ice on earth's surface and the occurrence of strange fauna and flora, but represents precisely the point of time when the study of geography acquires a vastly human interest. It was about the close of the Tertiary period, that the movement of man, from whatever place he might have taken his origin, began and the direction of his march was determined by land connections, the climatic conditions, the abundance of food and the absence of enemies. Everything about this pre-historic man, his dress, his implements, his crude craftsmanship, his food and his rugged appearance, his habitation and his hunting trophies have far more interest to us than the startling disclosures of a modern political intrigue or the romance of modern social life. How he incessantly battled with the forces of nature and used his intelligence in laying the foundation of modern industries and culture must at all times exercise a strange fascination upon reflective minds and possess an irresistible attraction for the imagination of the young.

Geography is the study of the changes not only of those occurring in the crust of the earth and the borders of the ocean, but primarily of the transformations taking place in everything belonging to man and his environmental relations. The study of the globe in its physical aspects, the height of mountain ranges, the length of rivers, the size of lakes and the depths of seas must be barren and the interest and cultural value of Geography must be derived from the age and area of plants and animals and the biological lessons which they reveal, the produce of the land and sea and the uses to which the modern industries put them, the means of intercommunication which have built up political institutions, the distribution of the different races of mankind and their isolation determining their level of social development and how from cruder and simpler types of family system, the enormously complex international life has arisen. These must be the legitimate province of historical, political or human geography and the influence of its study must always exercise a profound influence on the growth of human mind and its outlook. With the expansion and growth of political institutions the geographical frontiers have shifted and within recent years, the map of Europe has been altered out of recognition. These shiftings of frontiers are an expression of the drama of the struggle for life ceaselessly enacted in nature and repeated by man and the cause in both cases is identical. Over-population, shortage of food, desire of colonisation, and armed position are the causes which lead to expansion or restriction of political areas, and when the inhibition becomes too strong, the restlessness of the nations manifests itself in ethnographical or racial movements, eschewing foreign admixtures. All this is biological phenomenon and intensely geographical in interest in its historical aspects.

Pre-historic geography is mystic and romantic; physical geography dealing with climate, the sea and the changes on the land's surface and its productivity, is a study of the grim forces of nature; historical or political geography is the story of the evolution of social and economic institutions and human geography provides the absorbing background for all these divisions, by making man the centre towards which every other aspect of geography converges. The study of man is one of actions and reactions; it investigates the conditions which lead to over-population and distribution and the influence on them of the geographical features of the country inhabited by him and his capacity to adapt himself to the changing environment, his struggles and his survival value. In these struggles, with the powers of nature, his character and personality unfold themselves, and how the physical features of a country have moulded the national characteristics and its historical destiny is part of the evolutionary aspects of geography which must excite imagination and cultivate understanding. The study of physical features of countries such as India and Greece must offer scope for the investigation into the rôle while geography plays in developing religious and moral ideas of the people. The profusion with which nature supplied the wants of man without demanding labour for procuring them, supplied him with opulence and leisure leading to contemplation of the stupendous natural phenomena by which he is surrounded and out of such meditations which could not search the fundamental causes all theistic forms of religion and the primitive forms of nature worship rose. Geographical conditions of Arabia and Palestine must certainly have influenced the development of Judaism and Islam, whose stern simplicity and unitarianism are the products of the desert solitude and the temper of mind it fostered.

Geography, as Lord Meston conceives it, helps us to understand where the defect in the eternal struggle with nature has been final and where victory can be snatched and how harmony with nature can be established. The conflict is not all with the blind forces of nature, but it has to be waged between ethnic groups for racial domination and the results to which such conflicts lead are well known. Viewed from such broad standpoints the materials of geography form the subject-matter of other more specialised branches of knowledge and the cultural value of their study must be as wise and deep as human civilisation itself.

Section F.—Economic Science and Statistics.

PROFESSOR J. H. JONES, the President of the Section, in his address spoke on the value of the gold standard. The address is of immense value especially in view of the present state of affairs in the world. He spoke about the working of the gold standard before the war, then about the effect of the war upon the financial machinery and then gave an account of the post-war history of the gold standard. "If we ignore other metallic systems, the real issue lies between the gold standard rigorously interpreted and the maintenance of national currencies which are not linked together by being linked to gold or any other common measure." Abandoning of the gold standard achieved considerable popularity for a time; later experience is that currency disturbances lead only to increased difficulties. Gold standard is useful to countries to pursue a currency policy, to maintain a stable price level. A national system of currency is applicable only to a country which wishes to isolate itself from the rest of the world. It is inconsistent with a policy of internationalism in other branches of economic activity. The gold standard stands for internationalism in economic affairs. It is a condition for the free development of trade between countries. Post-war changes in the value of gold have been due not to the gold standard but to the failure of a number of countries to operate that standard. Restoration of the gold standard is necessary to the progress of the world. But it is not suggested that an immediate return to the gold standard is desirable, before certain preliminary conditions are restored, such as the price averages of different countries expressed in their respective currencies have reached those heights which may be considered satisfactory. But it may happen that political considerations will drive countries to take to gold standard before the necessary preliminaries have been properly considered. There is also the question of unequal distribution of gold. It is said that a return to gold standard is impossible so long as the world's supply of gold is concentrated in two countries. But this is not really an insuperable difficulty, for if we could restore these conditions which are essential for the maintenance of the gold standard it is not unlikely that a redistribution of gold according to apparent need would be accepted. It is, however, true that "the gold standard is a form of discipline which may itself help to restore some of those conditions that enable it to be operated with success."

Section G.—Engineering.

IN his Presidential Address at the Engineering Section, Mr. Richard W. Allen dwelt on the outstanding developments in Mechanical Engineering during the past few years. The improvements in time-saving and labour-saving devices have been so rapid that it often seems doubtful whether mankind can adapt itself to the rapidly changing conditions. The last fifty years saw the three most important contributions to mechanical science, namely, the steam turbine, the Diesel engine and the centrifugal pump. Electrical generation and transmission have also so rapidly increased that Lord Kelvin's statement, made as recently as 1895, that power stations of 100,000 H.P. under one roof would be possible in the future, has been more than justified because at the present day there are single units developing more than this power.

In the field of the steam turbine the great pioneering labours of Sir Charles Parsons laid the main foundations for the turbine design of to-day. From the uneconomical non-condensing turbine, the condensing type was conceived, thus increasing the efficiency to a very great extent. The geared turbine made it possible to be adopted to ship propulsion, to driving electric generators and to operating various kinds of mills, where its greater economy of space and steam consumption gave it advantages over the steam engine. The thermal

efficiency has also increased so rapidly that at present, a figure of 34 per cent is possible.

The development of the oil engine has not been less phenomenal. Although it is only 41 years since Rudolf Diesel took out his patent, the advantages of the Diesel engine for land and marine service have been fully recognised. Considerable developments in the method of fuel injection, in speed, and in power per unit weight have been achieved. The low initial cost, the limited space required for its installation, the ease of starting from cold and the low costs of operation and maintenance have all contributed to the great industrial exploitation of the Diesel engine.

The centrifugal pump is also largely a development of the last fifty years, although its principle was known long before. Osborne Reynold's patent in 1875, of the multistage turbine, centrifugal pump and the use of guide vanes, established a very wide field of application for this type of pump, even for the handling of materials like coal, sands, gravel and the like, besides liquids. The axial flow type is a recent development in this field. The tin industry of the Federated Malay States and the large floating and growing docks of to-day have largely been made possible only by the aid of this pump.

Similar phenomenal development in naval and military services, radio-communication, aviation and transport have taken place. The whole outlook has entirely changed due to the substitution of science and the scientific method for the "rule of thumb" procedure of the so-called "practical man" of the previous generations. The lay-out of plant, the housing of machinery, the transport question, the introduction of the planning department, the testing department and the works laboratory, are all due to the adoption of the scientific method of outlook. In achieving this end, all engineers owe a debt to the National Physical Laboratory, the British Standards Institution and to the technical press of the country.

The training of the future engineer, the craftsman and the apprentice are then dealt with at length.

Section H.—Anthropology.

TRADITION is the unwritten code handed down from generation to generation, influencing profoundly every department of human thought and activity. We have traditional methods of agriculture, craftsmanship, eating, dealing with property, marriage, rituals, and social relations and etiquette, superstitious faiths, games and sports and even narratives of semi-religious events and studies. The long-continued observance of certain rules and practices for regulating human affairs and institutions soon acquire the force of law and in primitive social groups, the younger members must become versed in the traditions of the society before they are permitted to the privileges of "citizenship" of the group. In the case of unregulated minds, tradition, whether rational or otherwise, exercises absolute sway and its influence on every aspect of human life in semi-savage societies amounts to religious sanction. Lord Raglan's address is devoted to the consideration of traditional narrative in its various forms such as "Myth, legend, epic poem, ballad, saga and fairy tale" and the contribution of each of these to history. The historical and fictitious aspects of traditional narrative must be an interesting field of anthropological investigation.

The essence of tradition is its oral transmission from age to age and its contents relate to the heroic exploits of mythical persons, the mystic practices of rituals and the observances of certain social rules or procedure in the practical affairs of life. It flourishes in illiterate and semi-civilised communities and lingers even in the highly cultivated societies. The contribution of traditional narrative to history cannot be trustworthy because the illiterate people are notoriously indifferent to facts and the genuine sources of history are well authenticated documents of events and careers of great men. Perhaps the reason why historical facts are capable of being transmitted with accuracy from generation to generation is that the events are contemporaneously recorded and they affect the fate and fortunes of countries and the recollections of these events must be far too vivid to undergo distortions from which traditional narratives are apt to suffer. For this reason historical facts rarely enter into tradition.

Do the illiterate people invent fables and fairy tales which are obviously intended to please and profit the community? Traditional narratives, according to Lord Raglan, are rules for the performance of rites or ritual dramas. The prosperity of the community depends upon the correct observance of these rules, which form the basis of traditional narrative and it is almost impossible for figments of imagination entering into such narratives because the rites or ritual dramas are enacted in the presence of all the members of the community. Primitive man is incapable of embellishing or distorting tradition and beyond being a repository of legends, sagas and poems, he is devoid of all faculties of imagination. The large number and variety of traditional narratives prevalent among peoples have been built up by the ritual practices and ritual drama.

Family and local traditions do not form part of historical facts and to a large extent may arise from confusion of tribal names or from gratification of parochial pride. The family tradition of Sir Hereward Wake which Lord Raglan quotes is an instance of such a confusion of names. It arises from a desire to connect pedigrees with an ancient name, however mythical, for the purpose of securing sufficient antiquity. Local traditions are false history started by the local Antiquaries and the traditional accounts of Henry V of England made famous in the historical plays of Shakespeare are opposed to historical facts of the early life of this sagacious monarch. Similarly, folk tales and songs and anecdotes have no foundation in history. Lord Raglan's theory is that the traditional narrative is always an account of a ritual drama and this view is based on the fact that in tribes and localities where traditional narratives abound, ritual dramas are numerous and elaborate. The principal ritual drama is the "creation rite", the installation of the king or the old king ceremonially killed by his successor. In all primitive social organisations, the ritual was practically universal, but the myth associated with the ceremonies and festivals partook of local character. If the myths and legends have their origin in the world of ritual drama, then the place of history in it becomes meaningless. In the process of evolution the ritual dramas undergo

transformations and among the numerous instances of such transformations, the cycle of Robinhood which forms the most important body of English and Scottish traditional narrative is a classic instance. May celebration was called "Robin Hood's Festival". He was a mythical hero whom the people were fond of personating in semi-dramatic performances and dances usual at that season. Lord Raglan concludes that all traditional narratives are accounts of ritual drama and gives a summary of their principal features. A narrative is generally dramatic, but history is seldom so. The action of the narrative is based on songs and rhymes and the language of the characters though coming from different countries is the same. Again in costume, conversation, conventional settings and in other important particulars, traditional narratives may be cast in quasi-historical language but cannot be true history. If in the early historical works, there are traces of traditional narratives as in the case of Herodotus and Thucydides, such references as for instance the historical character of the *Illiad*, are due to the methods of treatment which must be unscientific. The foundations of social anthropology have been encumbered "not merely by the ruins of ancient superstitions, but also by the jerry-buildings of pseudo-history and pseudo-psychology" with the consequence that the subject is not accorded a place among the sciences. "It will never occupy what should be its proper place until a vast quantity of pre-scientific and pseudo-scientific rubbish has been cleared from its path" and Lord Raglan's brilliant address ought to assist the clearance.

Section I.—Physiology.

PROFESSOR E. D. ADRIAN discussed the "Activity of the Nerve Cells".

The problem before us is whether it would be reasonable to discuss the working of the Nervous System with reference to its constituent cells. The Nervous System is responsible for the behaviour of the organism as a whole or, to use the classical phrase of Sherington, "its action is an integrative one". In the human we have not merely a Nervous System but also a mind. But we can discuss the activity of the nerve cells purely on the physiological plane. The Nervous System is composed of cells containing living protoplasm (which in itself offers any number of bewildering problems) but their more important function is to make the organism respond rapidly and effectively to changes in its environment and to achieve this they have developed a specialised structure and a complex arrangement in the body.

In the study of the development of the Nervous System emphasis was laid before on how the pattern of the Nervous cell is laid but now the approach is from why they are arranged in such a manner. In tissue culture and other variety of experiments it is possible to rearrange the geography of the Nervous System showing its plasticity—the forces moulding the system coming partly from the central mass of the nerve cells and partly from cells outside. The forces may be electrical or chemical, the nerve cells cling to structures already laid down, *e.g.*, the main arteries and the lymphs.

The Nervous System is made up of neuron cells with threadlike extensions. The activity is essentially rhythmic, probably a rapid breakdown and repair of the cells. The evidence comes from the analysis of minute electrical changes of cell activity sets as electrical Eddies. An external stimulus acting on a sense organ upsets delicate equilibrium of its surface the disturbance acting along the fibre while active process analogous to the spread of a flame along a fuse. The change is momentary excitement being followed by a rest and recovery. The impulses in a fibre may be as high as 300 or as low as 10. The sole function of the nerve fibre is to carry message without distortion. But these specialised reactions are not peculiar to the Nervous System and it may be observed that the ground plan of the mechanism is the same in the nerve cell or muscle cell.

The elaboration of our impulse is another problem, Sherington having worked on the Spinal Reflexes and Pawlow on the Brain. An important line of attack is by measuring electrical changes in the central grey-matter. It is found that there are large electrical oscillations in the cerebral cortex varying from moment to moment and difficult to experimental control. In the more measurable fibres of Optic retina it is found that there are waves in regular rhythm. It seems probable that both chemical and electrical changes may be concerned in spread of activity from one neuron to another. Our Nervous System is built up of cells with specialised structure and reactions—but the reactions are of a type to be found in many other cells. There are electrical gradients at an active point and it is a long step from the mechanical precision an impulse discharge to irregularities of the record from the cerebral cortex.

In considering the Nervous System as a whole clinical neurology has slightly emphasised exact localisation though this does not afford the whole explanation of cortical activity. Localisation as is now known is a matter of various than of single neurons. This is shown by an examination of habit formation and by remarkable way in which Nervous System adopts itself to injury. When the Central Nervous System is injured there is a greater evidence of localised function but that localised function is not a hard and fast rule. In reactions where there is no evidence of localisation, Lashby finds the important factor to be the total—mass of cortex.

How do the individual neurons combine to form a system capable of exactitude? This is as yet not possible for Physiology to explain but at distant date the solution may be found—not foreign to the conceptions of Physiology. The organisation of neurons into the Nervous System is yet a physiological problem and if a solution has to be found outside Physiology it will be interesting to know as to what light it throws on the relation of the Nervous System to the mind.

Section J.—Psychology.

IN delivering the Presidential Address of the British Association for the Advancement of Science at Leicester on the 8th of September 1933, Professor F. Aveling stressed the importance of mind over sensory experiences and made an emphatic plea for the status of psychology as an empirical science. All the sciences of Nature begin in sensory experience, abandoning the experience of conceptual construction and return to experience

to verify their constructive work. Empirical science is defined as the science which is supported by the evidence of the senses or which is built up out of the elements of experience. Physical sciences which begin and end in sensory phenomena are examples of the first and psychology an example of the second; but the ordinary use of the term 'empirical' limits experience to that of a sensory nature. This limitation is an arbitrary one and is due to a philosophical prejudice. There is no doubt that there is more in experience than in sensory elements. Empirical sciences which begin with sensory material, work from this towards its explanation on conceptual lines: and those sciences like Mathematics, which begin with abstract quantitative concepts work from these concepts and their relations towards a statement of the implications which are contained in them. Both these kinds of sciences are selective of their material and leave out of account much experience, which as such is as good as any other. "These neglected experiences are necessary to explain the constructions of the empirical sciences of Nature, for we need no longer concern ourselves with the deductive sciences .... It is psychology concerned with the totality of experience, objective and subjective alike, of which we are or may be conscious, and making no abstraction from the fact that it is experience, which provides an account of the empirical origin of principles of systematization and explanatory concepts alike which are found in the other sciences." On the other hand psychology is the most empirical of all sciences "in the sense that it deals directly with experience as such, makes no partial selection, but embraces all experiences alike indifferently and at their face value."

Section K.—Botany.

IN this exhaustive account of the types of Entrance mechanism of the traps of *Utricularia* (including *Polypompholyx*) the minute structure and behaviour of the valve and its contactual parts specially the threshold of seventy species of Bladderworts belonging to two major ecological groups are described. The trap is a snap-action mechanism—so swift is it that the whole action falls within the limit of 1/16 second. During this brief moment the side walls of the trap spring out, the door opens fully and closes half relaxed, when a column of water with small luckless animals rushes into the trap. The resetting of the trap takes place from 15 minutes to 2 hours or more during which period the water diffuses out of the trap and as a result of which the outer water presses equally on the walls and the door alike. The door is shifted out of its position, the water pressing thereon pushes the door in. Thus the trap is actuated. The water-tightness is maintained by a Velum which arises from the Epithelium of threshold. The structure of the door in all the species studied as correlated with the function of its various regions, remains uniform. Two general types of traps are noticed, *i.e.*, those that have broad threshold and those with narrow threshold. The characteristic glandular trichomes and their distribution in the trap has been observed. The details of several types are appended such as *U. cornuta, U. capensis, U. Cœrulea, U. monanthos, Polypompholyx, U. globulariæfolia, U. orbiculata, U. vulgaris, U. reniformis* and *U. purpurea.* In all these, living forms from the old as well as the new world have been studied.

Section L.—Education.

THE Presidential Address of Mr. Holland to the Educational Section is a brilliant review of the principal educational developments rendered possible by the passing of several Education Acts commencing from Forster's Act of 1870 to Fisher's Act of 1918. These Acts deal with the elementary and secondary educational systems, their administrative control, the governing bodies and the distribution of grants, and on the whole the energy and zeal displayed by the County Councils and the County Borough Councils which were charged with responsibility for all forms of Education in their areas, deserve ample recognition by state for the excellent use they have made of the opportunities. The development of a sound national system of Education in a democratic country with conflicting public and private interests must be comparatively more difficult than its organisation in states with a unitary national purpose. In Russia which is dominated by a single idea, the whole aim of education is to train the young man to become a worker for consolidating a socialistic state. Under the Nazi administration Germany is giving up her liberal notions of free individual development. The child is part of corporative state and has no existence apart from it. The idea of education is service and subservience to the state. In Italy the teacher and pupil own allegiance to Fascism and education has no ideal higher than the glorification and advancement of Fascist movement and all other considerations are subordinated to the exigencies of the State. Concentration on a single aim such as the central European countries have placed before themselves will undoubtedly simplify and speed up the educational reform, but in countries where the demands of the public are neither simple nor uniform, the task of building up a homogeneous system is fraught with complexities and difficulties. We cannot organise a department of national Education which will reconcile the conflicting demands of the parents, of the Society, of the industrial organisations and of the State and these demands change frequently in proportion to the changes in the economic and political system of the people. In adjusting the system of education to the requirements of these very often conflicting interests, it should not lose sight of the important task of providing an atmosphere for the free and ample development of the personality and character of the child. In a free country untrammelled by any political or socialistic incubus, the primary duty of the state is to offer extensive opportunities for the children and young persons to benefit to the fullest bent of their natural aptitudes, from any system of education by which they are capable of profiting. It is this assertion of the individual rights which is at once the strong and weak point of the British system of Education and it is this feature which baffles the efforts of would-be reformers of Education in England who wish to reconstruct a system on the socialistic basis of the state.

The secondary education in almost every country has reached a stage of development when

further reforms are possible only by reorientation of the entire outlook and purpose of this grade of instruction. With the awakening of mass consciousness to the benefits of education and the increasing opportunities it offers for the betterment of the social and economic position of the communities, the secondary schools have ceased to be exclusive institutions of a class. They have turned numbers of young men of practical ability toward professional and clerical occupations, a diversion causing no small amount of uneasiness to industrial and commercial concerns. Any system of secondary education which does not set out to discover their natural talents to boys and girls, but creates a thirst for soft sinecure posts in State Services, is wasteful and the country loses the benefits which might otherwise accrue, by the employment of the creative faculties of the young people. Boys and girls who now prefer the labours of the desk might possibly be diverted to industrial occupation through the new type of service schools which are rapidly coming into existence; the success of these schools must depend upon the public support accorded to them in a measure so unreservedly extended to the secondary schools.

The relation of education to industrial and commercial organizations is discussed in great detail in the address and the reasons why secondary education has become a part time and post employment one are set forth. The success of all endeavours in educating the employees must ultimately depend upon a co-ordinated plan in which the responsibility is equally shared by the employers and the local authorities. Technical education in other European countries has tended to divide society into horizontal sections offering no stimulus for personal advancement and individual self-expression and technical schools with such ideals will never succeed in discovering the exceptional man upon whose energy and genius, all industrial expansion must depend. In the concluding portion of the address the problem of unemployment of young men and women whose numbers are increasing is dealt with. Fundamentally it is a problem for the solution of which the state must assume responsibility and we do not agree with Mr. Holland who points out that it is a subject for the local education authorities to tackle. The suggestion that the young people should be advised to remain at school till proper situations are found for them is no solution and the maintenance of pupils in the school beyond the necessary period must be viewed by parents with alarm and by the Government not as a helpful suggestion, for in both cases the money spent on educating the young men after the completion of the courses must be wasteful expenditure. Mr. Holland makes other suggestions such as the age of compulsory insurance being lowered to fourteen years, and credit being given against the unemployment fund for attendance beyond that age, and grants being obtained by local education authorities, from the Board by submitting area schemes of Fisher's Act of 1918. Admittedly all these are only palliatives and are not real solutions and social consciousness should be thoroughly roused to the demoralising effect of enforced idleness of a large section of able-bodied citizens on the efficiency and productive-power of the nation, before the major part of the question may be deemed as having been solved.

Section M.—Agriculture.

DR. ALEXANDER LAUDER'S address is a review of the contributions of chemistry to agriculture since the year 1880 when Sir Henry Gilbert addressed the Association on a similar subject.

The past fifty years have witnessed several discoveries of fundamental importance, among which particular mention should be made of the fixation of atmospheric nitrogen, the rôle of vitamins in animal nutrition, the theory of base-exchange in soils and the principles of bacteriology. Some of these have found application in practical agriculture while the others have greatly improved our knowledge of soils, fertilisers, crops and animal nutrition. Our organisation for demonstration and advice are also more efficient, so that it is now possible for us to assist the farmers more effectively than at any earlier period.

The soil has been studied from both academic and practical points of view. Extended surveys have been conducted and vast areas have been carefully mapped. Several new methods for determining the availability of plant nutrients have been devised and although none of them has proved fully satisfactory, yet the estimates obtained by them are more reliable than those by any of the earlier methods.

In the field of fertilisers, synthetic production of ammonium salts and nitrates, the discovery of the fertilising value of basic slag and improved methods of manufacturing superphosphate, deserve special mention. Attention should also be drawn to the new synthetic concentrates containing varying proportions of nitrogen, potassium and phosphorus.

Biochemical researches have, in no small measure, contributed to the advancement of our knowledge of plant and animal nutrition. The application of X-Rays to the study of plant tissues, the discovery of the chemical nature and mechanism of function of chlorophyll, increasing knowledge of the rôle of enzymes and investigations on the nature, behaviour and more recently, concentration and synthesis of vitamins are only a few of the outstanding contributions of the period.

In recent years, the opening of a number of research stations, establishment of bureaux of information for disseminating fresh knowledge, development of improved methods of packing, transhipment and marketing different products have also proved to be of great service to both farmers and dealers in agricultural produce.

Much more yet remains to be done. Particular mention should be made of the need for improved systems of cropping, so that crops of high nutritive value may displace those of inferior quality. Lands of poor yielding capacity should be improved so as to maintain more cattle, sheep and poultry than at present. The possibilities of further reclamation of land should also be investigated.

Dr. Lauder's address is a useful compilation but it is unfortunately lacking in freshness of outlook. Discussion of a few of the most outstanding problems in agricultural chemistry together with some suggestions regarding new lines of attack would have greatly enhanced the intrinsic value of the address.

Research Notes.

Biological Observations on Ophiurids.

I.

IN a recent paper forming one of the series entitled "Papers from Dr. Th. Mortensen's Pacific Expedition, 1914-16" (LX) (*Vidensk. Medd. fra. Dansk. Naturh. Foren.*, **93**, pp. 1-8, pl. 1, 1932), Dr. Th. Mortensen gives a very interesting account of the unusual features of the Ophiurid, *Ophiocanops fugiens* Koehler, 1922, which had been imperfectly described. This species lives in moderate depths in the Philippine Seas and adjacent waters. The chief features of this extra-ordinary Ophiurid are: (1) the extremely small-size of the disc, (2) the absence of ventral interradii and bursæ, and of the mouth-shields except the madreporite which is as large as an adoral plate, (3) the uppermost of the arm-spines, which is also the longest, is upwardly directed in the skin of the dorsal side of each arm forming a series of chambers extending to nearly three-fourths of its length, (4) there is usually a pair of gonads to each joint opening separately on the side of the arm, and (5) the small stomach of the disc has radiating branches extending into the space above the genital organs in each arm, and thus providing an ample absorbing surface. The vertebræ and the articulation are a slight modification of the streptospondylous type found in the Euryalids, but the extraordinary arrangement of the arm-spines, the gonads, and the stomach is unique in Ophiurids and does not entitle the species to a place amongst the Euryalids or Ophiomyxids. Dr. Mortensen has, therefore, erected a separate family *Ophiocanopidæ* n. fam. to receive this species.

In the same paper (p. 21) Dr. Mortensen records the occurrence of an albino *Ophiocoma scolopendrina* (Lemarck) from Port Louis, Mauritius. The colour of the species is usually dark, mottled with white, but in the specimens that the author observed the black ground colour was entirely absent except at the tip of two of the arms.

H. S. R.

II.

IN another paper (LXIII) of the same series (*Vidensk. Medd. fra. Dansk. Naturh. Foren.*, **93**, pp. 171–194, 1933) Dr. Th. Mortensen has recorded some interesting biological observations on Ophiurids collected in the Indo-Pacific region which are summarised below:

1. The author describes an extraordinary little epizoic ophiurid, *Nannophiura lagani* gen. et sp. nov. found living amongst the spines of the oral side of *Laganum depressum*. It is the smallest of ophiurids hitherto known, with the disc not more than 0·5 mm. in diameter. It has 5 equally developed arms 3 mm. long, the distal part of which is broad and flattened with the spines partly modified into hooks, and in life has been observed to cling oral side away from its host to the spines by its prehensile arms which roll up towards the aboral side. The disc is made up of one central, 5 radial, and 5 small marginal plates. Ventral interradii and genital slits are absent. The ventral and dorsal arm plates are well developed, and there are no tentacle scales beyond the first. The mouth papillæ are rudimentary. The radial nerves are exceedingly well developed in correlation with the prehensile apparatus. This little ophiurid is by no means a parasite as it clings oral side away from the surface of the host, but it apparently finds a safe abode amongst the spines of its host which carries it about on detritus at the bottom of the sea. The detritus whirled up by the ciliary currents produced by the skin of the test and the spines of the host probably forms its main article of food.

2. The practice of autotomy as a means of propagation is well known in the Ophiuroidea and other groups of animals but in the family Amphiuridæ this phenomenon appears to have been overlooked with the result that there are very few records of it in literature. The author describes a new species, *Amphiodia dividua* from a lagoon at Cannoniers Point, Mauritius, which reproduces by autotomy. The chief features of this species are that the disc has no primary plates, but is covered on both sides by small, thin, simply perforated scales of one size, that the radial shields are elongate, very narrow and contiguous along their whole length, which is nearly half that of the radius of the disc, and that each radial shield has a prominence at its outer end which carries two or three hyaline spines. The habitat of the species is peculiar, and harbours Synaptids, Euteropneusts, Planarians, Nemerteans, Annelids and two other species of viviparous ophiurids. The lagoon dries up at low tide leaving a thick mass of

much-tangled filamentous green algæ which retains some water, and the author suggests that the habitat of these ophiurids has some connection with their mode of propagation.

3. In the large sandy flats exposed at low tide at Polana Beach on the coasts of Dolagoa Bay, Portuguese East Africa, the author found among many interesting animals some small ophiurids on the oral side of *Echinodiscus disperforatus* Leske which usually lies concealed under sand. These ophiurids are described under the name *Amphilycus androphorus* gen. et sp. nov. The chief point of interest in this form is the occurrence of a male individual on the oral side of the disc with its arms alternating with those of the adult female in such a way that the mouths of the two sexes are opposed to each other. The males are very small, with their disc not exceeding 1 mm. in diameter, while the females have a disc with a diameter of 5 mm. The author regards this phenomenon as an extraordinary case of copulation hitherto unknown in ophiurids which differs from the only other known instance of "copulation among Echinoderms, that of *Archaster*, in being not temporary as in the said sea-star, but constant—a continuous erotic embrace, the female, evidently, carrying its male throughout life." The instances of viviparity in *Ophiodaphne materna* and *Ophiosphœra insignis* recorded by Koehler in his Memoir on the Ophiurids of Australian and Malayan Seas are, according to the author, really a case of sexual dimorphism in which each female is accompanied by its much smaller sexual mate on the oral side of the disc.

4. In this note the author, discussing the occurrence of viviparity in ophiurids, adds four more instances of this phenomenon to those already known, and describes a new species of *Ophionereis*, *Ophionereis vivipara* from Cannoniers Point, Mauritius. He gives a list of the known viviparous ophiurids with remarks on the condition of the sexual glands, hermaphrodite or sexes separate, from which it is clear that the majority of viviparous species are hermaphroditic. The casual relationship of viviparity and hermaphroditism is unknown, and the author leaves the problem open with the remark that hermaphroditism is in some way connected with viviparity, and has been acquired gradually among the more specialised forms.

H. S. R.

Floral Anatomy and Its Morphological Interpretation.

IN a recent paper on the subject (*New Phyt.*, Aug. 1933), Agnes Arber shows that the differences between the flower and the vegetative shoot are conditioned in the main by three factors: (1) The divergence of the floral members from the foliage leaf type in correlation with the difference between sporogenous and vegetative activity. In the carpel this involves the shifting of activity from the midrib to the margins. (2) The peculiar relation of the ultimate leaf members (carpels) to the apex of a shoot of limited growth (the floral axis). (3) The telescoping of the floral axis, and its intimate association with the parent axis and bract, which leads to close packing of the appendages, and favours cohesion, adhesion, and various forms of distortion, suppression, and departures from radial symmetry. With this theory of the flower as a basis, she considers the phylogenetic claims of floral anatomy. She holds that the general scheme of vascular system may have some value as indicating the broader trends of race history, but from a study of certain rudimentary leaves, sepals and stamens, it appears to her that there is no positive evidence for the alleged 'conservatism' of vascular bundles or for their survival when the organ which they supplied has ceased to exist.

Mucus Formation in Goblet Cells.

MR. E. S. DUTHIE in an article on the "Mucus formation in Goblet Cells"(*P.R.S.B.*, 784, 1933) starts with a brief review of the previous work done by Nassonov, Clara and more recently by Florey. Vital stains and also the classic technique have been employed and the subjects of the experiment were young and adult mice. The secretory granules make their appearance at the periphery of the cells where the mitochondria abound. Having thus made their appearance possibly due to the influence of the mitochondria they migrate into the Golgi region where the transformation into the mature mucin granules takes place and this is stainable.

Plant Galls as Natural Checks to Wild Vegetation.

OUR knowledge of the rôle of plant galls in the economy of Nature is very

fragmentary. Since 1928 the writer has been interested in this highly fascinating aspect of cecidology. A preliminary study in the South Indian region has yielded certain extremely interesting results, which it was thought worth while to record here.

One of the important parts played by plant galls in Nature is that of natural checks to the abnormal spread of wild vegetation. Many species of galls effectively keep wild plants within certain normal bounds. But for the formation of these galls, which reduce their numbers, the plants now bearing them would spread over much larger areas of any locality. They would grow and spread so luxuriantly as sometimes to choke out of existence all other plants, which might happen to be cultivated and economically useful to man. Without such galls to our aid our constant fight against many noxious and troublesome weeds would be far tougher than now and we should have many more weeds on cultivated land. The extremely troublesome weed *Lantana* would be a more formidable enemy to the agriculturist than even now, but the formation of the fruit galls on *Lantana* by a gall-midge *Asphondylia lantanæ* Felt. reduces the number of seeds produced to 50% to 60%. This in turn aids to keep the species within reasonable limits. South Indian jungles should be richer than now in *Morinda tinctoria* Roxb., if the latter does not bear the newly discovered flower galls by *Asphondylia morindæ* N. sp. This midge produces galls on the flowers of 80% of the plants and only a much smaller portion of the rest develop into ripe seeds. *Mimusops hexandra* Roxb. would form denser societies in the South Indian scrub-jungles but over 95% of its flowers turn into a curious, undescribed gall. In a certain scrub-jungle in South India, due to an exceptionally moist and favourable condition in 1931, the wild twiner *Rivea hypocrateriformis* Choisy. spread and produced an unusually larger number of flowers. It was estimated that the flower production in the previous two years was 50% less than in 1931. This increase in flowers in 1931, however, did not bring about in 1932 any unusual increase in the number of plants in the locality or in the neighbourhood. This was due to the fact that in 1931 and 1932 gall-formation on the flowers by an undescribed Itonidid (*Cecedomyid*) was nearly 35% more prevalent than usual. The galls prevented the seed formation and hence kept down the number of plants.

All species of galls do not behave equally in this respect. Those species which involve in their development flowers, fruits, buds and roots are the most effective checks. Flower and fruit galls especially keep down the plants incapable of vegetative modes of reproduction. Sporadic forms of galls do not so effectively play this rôle as the epidemic ones. Due to the formation of galls on them, the flowers fail to reach maturity and seeds, which are needed for propagation, are not formed. This very seriously affects the spreading of the plant in the absence of a vegetative mode of reproduction. In any locality with a hundred or so of plants so affected only a few flowers develop normally and contribute to the spreading of the species. The species is thus checked. This, for instance, is the case with *Lantana* sp., *Mimusops hexandra* Roxb. and *Rivea hypocrateriformis* Choisy. Even when the plants with flower galls are capable of vegetative modes of reproduction their number is very much reduced. Gall-formation on roots so weakens the plants by under-nourishment that the production of an over abundance of flowers is very seriously affected.

There are a number of other instances in which galls play this part to a much larger extent than any cited here. Indeed the whole subject is very intricate but its full importance is not generally known. The present note merely aims at showing the extremely interesting field available for work. A detailed account of the subject is put off for a future occasion pending a more thorough investigation.

M. S. MANI.

The Investigation of Atmospheric Pollution.

THE Report of the observations made during the year ended 31st March 1932, which has been issued by the Department of Industrial and Scientific Research and published by H. M. Stationery Office, London (1933, Price 5*s.* net), makes very useful reading.

During the year under review, thirty-seven bodies—municipal, industrial or agricultural—co-operated in conducting the investigation. A number of useful observations were made, but the following deserve special mention. In view of the difficulties in obtaining accurate estimates of solid contents of smokes, attempts are now being made to devise a photo-electric apparatus for the purpose. Improved methods for the

estimation of sulphur impurities in air have been developed. The deposit-gauge measurements relate only to the limited areas covered by the instruments, so that generalizations therefrom for all the surrounding areas would not be justified. The results of analyses of deposits collected at different centres show considerable variations. A study of the averages for the past few years would show that the sulphur content of London fog has greatly increased while at other centres it has shown perceptible decrease. Ashington High Market gave the highest figure for total solids, ash and tar. Burnley Town Hall was richest in carbonaceous matter and chlorine. Others, like those from some of the country parks, gave low figures under all the heads.

Although India is not so much subject to dense fogs as Great Britain is, yet her dust problem is very much more serious. In view of the fact that dust is the chief carrier of a number of diseases, it is hoped that the Government would soon take up the problem seriously and appoint a competent staff to conduct the investigation.

Calcutta Fish Depôt.

CALCUTTA Fish Supply Co. (Managing Agents, *Agencies Co.*, India, 7-1, Lindsay Street, Calcutta) have opened a fish stall No. 109-110, Municipal Market, Calcutta, for the sale, under European supervision, of foreign sea fish in fresh condition and country sea fish. The stall is daily open for business from 5 to 10 A.M. The supply for the daily requirements is drawn direct from the cold storage at Kidderpore. The following foreign fish are sold: Sockeye Salmon, Red Salmon, Haddock, Herrings, Kippers, Bloaters, Flounders, Halibut, Trout, Snappers, Soles, Smelts, Cod, White Fish, Shrimps and Lobsters. The country sea fish are Bhetki ("India Halibut"), Indian Haddock, Indian Salmon, Indian Mackerel, Hilsa and Pomfret. The prices in September ranged from annas 7 per pound for Hilsa to Rs. 1-4-0 per pound for Lobsters and Halibut.

The entire stock of the foreign fresh fish is imported from British Columbia (Canada). Before shipment, the fish is gutted, cleaned and subjected to rapid freezing by Ottisen Process. There are only two boats that have arrangements to carry fresh fish, so the supply is received every two months. In 1932, the quantity of fresh fish imported was about one ton, but during the current year it is expected that import will be about 6 to 7 tons. The business is confined to Calcutta and the customers are mostly Europeans. At present it is a losing concern, but is said to be full of great possibilities, especially in the town of Calcutta, where practically the entire population consists of fish-eating people and where, due to a ring of middlemen, the fish is sold at a very high price and is almost beyond the reach of poor people. If this new venture can help to break the ring and lower the prices, it will be hailed as a great boon in Calcutta.

The establishment of this new company for the supply of fish in Calcutta brings home, very vividly, the immense possibilities of developing the fishery resources of India. Our seas and inland waters are full of fish. A Central Organisation is needed that will pay attention to the conservation of the resources, and will undertake vigorous application of fish culture methods. It will then be possible to maintain and build up in India the population of the finny tribes and to make the profession and business a profitable one. It is within living memory how Japan and British Columbia have developed their fishery resources by the well-conceived application of scientific methods. "Where no regulations exist as to the method in which fisheries should be worked, and should other circumstances be equal, that country or District which is most populated by man will be the denuded of fish. Individuals would sooner live by fishing than by agriculture, as the trouble of capturing the finny tribes is less than tilling the soil, being simply catching without any idea of preservation." Those, who have studied the methods of fishing in the various parts of India, know how true all this is with regard to the fisheries in India and how imperative it is to devise some means of conservation and propagation.

Science News.

Mr. P. K. Bose, Department of Botany, University of Calcutta, has, in an article appearing in the August number of *Modern Review*, made a critical survey of the problem of Water Hyacinth—the Terror of Bengal Water Ways. As in the case of the lantana and several other pests a plant which was introduced for ornamental purposes for the sake of its beautiful flowers has now become a menace to the cultivation of economical crops such as paddy and a menace to commerce through its paralysing the water ways. The credit of introducing it into Eastern Bengal goes to Mr. George Morgan, a resident of Narayangunj, and the plant is often humorously called Morgan's folly. The plant bears extremely pretty mauve or pale lilac flowers and the main mode of propagation is vegetative, the bladder-like leaf stalks acting like buoys and keep the plants floating. The plant is thus enabled to grow in deep as well as in shallow waters and being a native of tropical and subtropical South America has found Indian climate extremely suitable. By its abundance of leaves, dense vegetation and innumerable rootlets, it impedes flow of water, and has displaced many aquatic grasses which were so characteristic of Bengal paddy fields and so useful as fodder for cattle. It has overrun cultivated paddy fields to an alarming extent and has threatened jute cultivation. Tanks which supply drinking water have been covered by dense mass of water-hyacinth thereby rendering clean potable water scarce and by causing water stagnation in ditches, and shallow waters provide suitable breeding places for mosquitoes and other disease-carrying insects.

Attempts at economic utilisation of the plant have proved abortive. The fresh leaves have been used to some extent as cattle fodder and this has resulted in the deterioration of the quality of milk and a run down in the general health of the cattle. Trials were made to get potash on a large scale, but the process was too expensive and would not pay. The inferior quality of pulp obtainable from the plant renders its exploitation for paper manufacture impracticable. Attempts were made to prepare writing ink from the flowers but the colour did not appear to be fast, and the project was abandoned. The green plant contains about 95 per cent. water and it is highly doubtful whether any useful product can be obtained from the dry residue. Composting the weed for producing manure could be attempted but so far no organised effort appears to have been made.

The extermination of this weed has to be undertaken on a mass scale. Researches into Biological methods of extermination have to be carried out. Common salt and sulphuric acid have been found to be effective in killing the plant but the application over any extended area offers immense difficulties. Mechanical dredging and lifting operations could be carried out with some benefit. Simultaneous action should be taken in Assam, Bihar and Orissa and United Provinces to eradicate the plant as it is really astonishing how one single plant producing numerous offshoots which break away from the parent and grow independently, can be the cause of infecting large expanse of water.

* * *

The Ninth Annual Report of the Geological, Mining and Metallurgical Society of India has reached us, as also a copy of the Presidential Address of Mr. K. Dutt, delivered at the Annual Meeting held at Calcutta on the 11th August. The Society records normal activities during the year 1932-33. Nine ordinary meetings were held at which 13 papers were read and discussed. Six issues of the Journal of the Society were published, comprising 22 original contributions, two of which refer to problems on Mining.

Mr. P. Sampat Iyengar, M.A., Director of Geology, Mysore Government (Retd.) was elected President for the year 1933-34. The other office-bearers and members for the Session 1933-34 are: Vice-Presidents: Dr. C. S. Fox, and Mr. M. M. Mukherjee; Joint Secretaries: Mr. N. N. Chatterjee and Dr. M. Chatterjee; Treasurer: Mr. S. L. Biswas; Librarian: Mr. B. N. Maitra; other Members of the Council: Prof. N. P. Gandhi, Dr. M. S. Krishnan, Mr. D. C. Nag, Mr. A. L. Ojha, Prof. S. K. Roy, Mr. Balaram Sen, Mr. K. K. Sen Gupta and Mr. D. N. Wadia.

In the course of the Presidential Address, Mr. K. Dutt dealt with the means and ways of putting on a sound basis the coal industry in India, which is the most potent factor in deciding a Nation's rôle in the field of manufacture. The problem of coal is closely linked with iron and although India is fortunate in possessing the necessary raw material, the Iron and Steel Industry is still in its infancy. The improvement of the metallurgical industries in India necessarily demands larger quantities of high class caking coal, and unless researches make it possible to use second class coal for caking purposes, a national calamity cannot be averted. The remedy for this lies in the manufacture of Petrol from coal which, thanks to intensive research in Germany and elsewhere, is now a practical possibility. In India a Fuel Research Board on the lines of the Imperial Council of Agricultural Research should be established forthwith to go into the question and investigate the possibilities of manufacturing petrol from coal.

The question of the soft coke industry also deserves consideration. Unless India produces soft coke of standard quality, suitable for fuel, by launching intensive research, the second class collieries will not be able to thrive. A permanent Fuel Research Board should be established immediately and the Government should be persuaded to take steps to utilize the surplus funds lying idle with the Coal Grading Board for maintaining the Research Board.

The lecturer suggested that the Society should try its best for establishing a research and statistical bureau with necessary financial aid from the Government and owners of metallurgical industries.

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In a communication entitled "The Filtrable Phase of the Tubercle Bacillus" (*Ind. Med. Gaz.*, **68**, 456, 1933) Dr. Soparkar has discussed the results of his experiments with suspensions of tuberculous sputum and tissues of animals in saline, filtered through Chamberland L_3 candles and inoculated subcutaneously into guinea-pigs. The passage of emulsions of lymph glands and spleens of previously inoculated animals, which were killed at regular intervals, revealed, on careful examination, acid-fast bacilli in 66 out

of 190 cases, the positive results being obtained with different stages of the passage. These acid-fast bacilli could be cultivated successfully, but the interesting fact observed was that the resulting strains differed culturally and in pathogenicity from the strains of bacilli present in the original material used for filtration. The conclusion, therefore, appears irresistible that there exists a filtrable phase of the tubercle bacillus when it can pass through a Chamberland candle, but a biological change is brought about so that the organism cultivated from the "filtrate" is *avirulent* for the animal and in some cases behaves like the avian bacillus.

* * *

In a paper entitled "The Case for the Electrochemical Fixation of Atmospheric Nitrogen in India" (*Madras Agricultural Journal*, **21**, 1933) Viswanath has pointed out the urgent need for manufacturing in India nitrogenous fertilizers through the fixation of atmospheric nitrogen. With all the facilities available, it is indeed surprising that the problem has not been investigated on a scientific basis in India particularly as it is so essential for the development of agriculture and increased food-production. The question was examined by the Royal Commission on Agriculture (1926-27) who reported that the prospects of producing synthetic nitrogenous fertilizers were not encouraging. It should, however, be noted that the world's production of nitrogenous fixation products is still below demand. The Sugar Committee, who had also examined the question, expressed the opinion that the introduction of synthetic process for nitrogenous fertilizers was a matter of great importance. Further, a close examination of India's food position shows that for feeding her ever-growing population the available natural supplies are inadequate and the artificial utilization of atmospheric nitrogen is necessary. India produces at present food sufficient for the proper feeding of only two-thirds of her population. It is, therefore, clear that every effort must be made to increase our food supplies. Although recent work has established the importance of organic manure in the soil, both for quality and quantity of food crops, yet it would be necessary to augment our natural resources of organic manures by artificial fertilizers. There is no doubt that there is at least a case for the "immediate institution of nitrogen research laboratories in which chemists and electrical engineers should work in close collaboration and co-ordination and tell us definitely what the position is."

* * *

At a meeting of the British Medical Union, South Indian Branch, held at Madras on the 22nd September, Dr. C. Muthu delivered an interesting address on "Some Biochemical and Sociological Factors in Health and Disease". The lecturer pointed out that the close study of the life's processes in the light of modern biochemistry and psychology has shown that for normal health fresh air, sunlight and well-balanced food are essential, and the internal organs receive from these sources materials necessary for the elaboration of harmones, enzymes and other secretions. The man's environment and social condition also profoundly influence his health and disease. Almost all diseases can be traced to deficiency of some food factors, proteins,—which are primarily body builders, vitamins—which in minute quantities are essential to life and for the growth and development of the body, endocrine secretions, and mineral salts. It has been amply demonstrated in recent years, that more could be done to maintain health through dietary reform by supplying deficiencies in diet than by drugs or any other agency we know of. The study of the nutritive values of Indian foodstuffs is of the utmost importance to-day and the medical man would have great success in the treatment and "prevention of disease if he gave more attention to man's nutrition and the sociological factors governing his every-day life."

* * *

In a paper entitled "Lethal Properties of Aqueous Extract of Young Bamboo Shoots" (*Indian Med. Gaz.*, 1933) Stewart and Moorthy give an account of their preliminary observations on the active principles of young bamboo shoots responsible for the larvicidal and insecticidal properties. It has been shown that free hydrocyanic acid is liberated due, probably, to the enzymic hydrolysis of cyanogenetic glucosides present in the bamboo shoot and the observed toxic effects on guinea-worm embryo, cyclops, maggots of the house-fly, adult flies, adult mosquitoes and eggs of *A. stephensi*, may be due to the hydrocyanic acid so liberated. There appears to be a second substance also responsible for the toxicity, the nature of which is being investigated.

* * *

An ordinary meeting of the Association of Economic Biologists, Coimbatore, was held on 4th September, for discussing original papers. Mr. T. S. N. Singh gave a paper on "Chromosome Numbers in the Genus Saccharum and its Hybrids," describing the chromosome numbers, both interspecific and intergeneric. The various forms now grouped under Saccharum spontaneum showed chromosome numbers varying from 27 to 64. In the case of Saccharum hybrids, the doubling on the mother side noticed by Dr. Bremer was not found in certain of the hybrids with Indian canes. A series of four bud sports obtained from Co. 213 showed different numbers from 46 to 62; the one with 46 being apparently a degenerate type.

Messrs. T. V. Ramakrishna Ayyar and S. Ramachandran gave a very interesting paper on "Bees and Bee-keeping in South India". A brief account of the honey bees we have in S. India and the native methods now in vogue all over India in artificial bee-keeping and honey gathering were described. The paper also gave a short account of the attempts which are being made by the Entomology section at the Agricultural Research Institute, Coimbatore, to demonstrate and popularise the modern methods of bee-keeping as is practised in many of the Western countries.

* * *

The Magnetic Interference Balance originally developed in Prof. S. S. Bhatnagar's Laboratory at Lahore has been put on the market by Adam Hilgers. This is a refinement of Oxley's magnetic balance in which the change in the inclination of a glass plate suspended by a bifilar suspension in one beam of a Rayleigh Interferometer is made evident by the movement of a system of Interference bands. The sensitivity of the balance is very high, as it is possible to read changes in the interference pattern up to a fraction of a fringe. A compensation arrangement is provided in the

instrument by which the fringes could be brought back to their original position and readings taken in terms of the movement of a graduated drum-head. The instrument is very compactly made and easy to set up. The balance is especially suitable for the investigation of weekly dia- or paramagnetic materials and for comparative measurements on closely related substances, but for work not demanding the great sensitivity of the interference method arrangement is provided whereby the original Oxley method may be employed.

With the growing importance of the subject of magnetism the balance fulfils a great need of the research worker in the field of magnetism.

* * *

We have received from Messrs. Bailliere, Tindall and Cox, 8, Henrietta Street, Covent Garden, London, W. C. 2, a catalogue of their latest publications in Medicine and Science. The catalogue is arranged in four sections: (1) Medical, Dental and Nursing, (2) Veterinary Foods and food inspection, Botany and Agriculture, (3) Science and Miscellaneous, and (4) Periodicals and Reports. The catalogue also includes subject and author indexes, and will prove useful to Libraries, Government Departments, Institutions, Hospitals, etc., requiring latest publications in these progressive sciences.

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We acknowledge with thanks the receipt of the following:—

"Nature," Vol. 132, Nos. 3328 to 3332.

"The Chemical Age," Vol. 29, Nos. 737 to 741.

"Canadian Journal of Research," Vol. 9, No. 1.
Do. do. Vol. 8, Index.

"The Journal of Chemical Physics," Vol. 1, No. 8.

"Experiment Station Record," Vol. 69, No. 1.

"Communications from the Kammerlingh Onnes Laboratory of the University of Leiden"—217 to 221.
Do. Supplement No. 69 to Nos. 205-216.
Do. do. No. 70 to Nos. 217-228.
Do. do. No. 71 to Nos. „
Do. do. No. 72 to Nos. „
Do. Vol. 19, Nos. 205-216.

"Journal de chimie Physique,"—Tome. 30, No. 7.

"The Mathematics Student," Vol. 1, No. 2.

"The Review of Scientific Instruments," Vol. 4, No. 8.

"The Scientific Indian," Vol. 10, No. 56.

"The Indian Forester," Vol. 59, No. 9.

"The Quarterly Journal of the Geological, Mining and Metallurgical Society of India," Vol. 5, No. 1.
Do. Index to Vol. 3, Nos. 1 to 4.

"Bulletin of the State College of Washington, Agricultural Experimental Station," Nos. 282 to 285.

"Contributions from the Boyce Thompson Institute," Vol. 1, Nos. 1-8; Vol. 2, Nos. 1 to 10, Vol. 3, Nos. 1 to 4; Vol. 4, Nos. 1 to 4; Index to Vols. 1 and 2 and Profession Papers 1 to 22.

"Indian Journal of Physics," Vol. 8, No. 1.

"Transactions of the Mining and Geological Institute of India," Vol. 28, No. 2.

Reviews.

THE MEASUREMENT OF AIR FLOW. By E. Ower, B.Sc. (Lond.), Hons. I., A.C.G.I. Second Edition, Revised and Enlarged. (Chapman and Hall, Limited, London, 1933. Price 15*s*. 6*d*. net.)

The second edition of this book dealing with the theory and technique of the measurement of air flow will be welcomed by all hydrodynamicians, who are interested in practical application of their subject, by engineers engaged on matters, such as fan engineering and ventilation of mines and buildings, and by meteorologists in connection with the theory of anemometers.

For the purpose of fluid measurements, direct methods are inapplicable, and it is therefore necessary to resort to the measurement of some physical effect arising from the motion. Three such effects have been found by experience to be suitable, namely, pressure changes associated with the motion; mechanical effects, such as the rate of rotation induced in light vanes suitably placed in the stream; and lastly, the rate of cooling of a hot body, such as an electrically heated wire introduced into the air current. The author describes in successive chapters the general principles of the pressure tube anemometers, design of pitot and static tubes, the flow of air in pipes, measurements of flow and resistance with pitot-static tubes, the plate orifice, Venturi tube, and shaped nozzle, the vane anemometer, miscellaneous methods of flow measurement depending on pressure observations, manometers, and methods of flow measurement based upon the rate of cooling of hot bodies. In the last chapter, a few typical examples have been given, from practice of the methods of measuring air flow.

The author's own researches have contributed largely to the theory of the vane anemometer and have led to important practical conclusions. For instance, it is shown theoretically that the angle at which the vanes of an anemometer must be set in

order that they may commence to rotate at as low a speed as possible is 31°. Actually, from experiments, the best blade angle for an anemometer appears to be about 40°. But on account of uncertainty regarding the variation of frictional and interference effects that exist at very low speeds, the discrepancy of about 9° between theoretical and experimental values is not regarded as excessive. Another practical rule deduced from theory is that in order to limit the error on indicated air speed to 1 per cent., an anemometer should not be used in a pipe of diameter less than six times the diameter of the anemometer.

The details given in the book of the dimensions and other factors of the various air flow gauges will be found to be of great importance by research workers in the field.

While such an instrument as a Kata Thermometer has found a place in the book for the measurement of air speed, we miss any account of the method of measuring air flow by "floating particles" or "smoke or filament lines", which are finding increasing use in modern aerodynamic practice, particularly in regard to turbulent motion.

S. K. BANERJI.

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PRACTICAL CHEMISTRY (For Intermediate Science Students). By N. M. Shaw. (Published by the Students' Own Book Depot, Dharwar. Second Edition. Price Rs. 1-8-0.)

Introduction of a few exercises on the determination of the composition of gases like ammonia, hydrogen chloride, etc., would be very desirable. The portion of the book dealing with qualitative analysis shows that much stress is laid on dry tests; no doubt they very often give useful clues regarding the nature of the substance. Otherwise the book is quite suitable for the Intermediate students of all Universities.

M. SESHAIENGAR.

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APPLIED CHEMISTRY REPORTS, Vol. XVII. 1932. (Society of Chemical Industry, London.)

The progressive chemist looks forward to the publication of the Annual Reports as a study of it enables him to keep himself abreast of progress achieved in various branches of Applied Chemistry. The obvious importance of such publications need hardly be emphasised. The flood of papers flowing into various Journals published in various parts of the world, thanks to the numerous fertile fields of Research in Applied Chemistry, makes it almost impossible for any Chemist to study all the literature, and he has therefore recourse to the annual reports and looks upon it as an essential addition to his library.

Nearly 3,300 references have been cited in the current publication comprising 26 different sections prepared by well-known specialists. The section on Explosives comprises work for the two years 1931 and 1932, a review on the subject not having appeared in the previous year. The Annual Reports appear in very familiar style, and deserve a merited place in every library.

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ROMANCE OF PLANT HUNTING. By Capt. F. Kingdon Ward, F.R.G.S. (Edward Arnold & Co. London. Price 3*s.* 6*d.*)

We have read Capt. Kingdon Ward's book on "The Romance of Plant Hunting" and judging from the material and the method of treatment, we have no hesitation in welcoming it as an addition to the works on Scientific exploration and travels.

"Full many a flower is born to blush unseen" and the plant hunter very piously sets before himself the arduous task of discovering these "Unseen" blooms and presenting them as gifts to the lovers of the beauty of nature. The task is rendered not merely difficult but full of enterprise as the hunter in search of new and hardy plant has to explore regions of the earth untrodden by man. Captain K. Ward takes us in a very racy and attractive style, through Yunnan, the Land of the Yellow Lama, where nature is a vast festival of multi-coloured flowers.

As a guide to the art of plant collection the book is an invaluable asset and gives us certain very timely and suggestive "tips". The first concern of the plant hunter is to secure for the civilised world a first class plant which for fragrance, colour, habit and abundance of flowers commands great admiration and respect. In several cases the plant may not survive the changes of habitat and it is a great responsibility on the part of the plant collector to give as accurate a description of the original habitat of the plant as possible to enable the plant breeder or horticulturist to duplicate the natural environment and in this respect also Kingdon Ward has justified the expectations of the reader.

The inherent love of flowers by the Englishman is the result of the climate and his roving disposition and the uncanny skill of an English gardener places him almost in the front rank of the gardeners of the world. The result of this is that the English garden is the envy of the world and the enviable position of the British as gardeners of taste and beauty is largely due to the labours of the scientific or the professional plant-hunters. In the West, people are accustomed to celebrate seasons when flowers are in blossoms with mirth and gaiety and the custom is seen to a limited extent in Oriental countries like Japan and China where form and colour appeal to the æsthetic sense of the people to so great an extent that the time of Cherry blossoming is a national festival with them. There is this difference between the Orient and the Occident: while in the latter it is beauty of form and colour that are the sole points, in the former there is always a touch of religion. The Japanese like the Indians worship trees in their temples and every month in the year has some plant dedicated to it. We hold that the Lotus is sacred to Vishnu and the Labiatæ sacred to Shiva.

We have no hesitation in suggesting that books of the type under review contribute in a large measure towards educating public taste creating a sense of the beautiful in nature and incidentally promote a sense of responsibility in the endeavours of the amateur plant collectors to discover, foster and perpetuate the "Unseen" beauty in the plant kingdom.

A. N. R.

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A PROBLEM IN EVOLUTION.—In recent years the controversy regarding the precedence of function or habit over form or *vice versa* has been revived with considerable vigour. Several workers have denied the existence of "adaptations" and believe that characters have arisen at variance with the innate tendencies of "heredity". In a recent article (*American Naturalist*, **47**, pp. 154-162, 1933) entitled "The Fishes of Lake Lanao: A Problem in Evolution" Dr. Albert W. C. T. Herre of the Stanford University, California, corroborates the views expressed by Regan (*Nature*, **113**, p. 569, 1924) that evolution in its main lines has been adaptive and that "changes in structure have been intimately related to, or even determined by, changes of function. As a result of extensive field-work, Dr. Herre has discovered a unique endemic fish fauna in the Lake Lanao which comprises exclusively of the Cyprinoid species. Dr. Herre believes that the seventeen or more species of Cyprinidæ found in the lake are descended from a single parent stock. It has to be remembered that the present lake was once a mountain ravine, which was dammed by lava flow long ago, and gradually the mountain stream changed to a large lake with a great diversity of conditions. Thus, according to Herre, "the changing conditions in the lake, with all its varied assortment of environment, imposed new demands upon the parent stock of fishes and eventually various new forms of more or less permanence or fixity appeared, some of which survived while others may have disappeared." The parent species is believed to be *Barbodes binotatus*, which, with the formation of the lake, became transformed into *B. tumba*. The latter is now to be found in the rapid waters of the small tributaries of the great lake. As Lake Lanao attained maturity, various offshoots from *B. tumba* arose, each with special adaptation for a particular environment. One set of species took up life in the clear blue surface water lying offshore in depths of 5 to 15 metres. One species has become adapted to life at a greater depth. In shallow, muddy bays black or dusky bronze species have appeared. There are others that live in the boiling eddies and swirling mad torrent of the Agus, the outlet of Lake Lanao. Between these, there are intermediate forms found in the intervening zones. Some of the descendants of *B. tumba* are so remarkable that they have been referred to new genera. Dr. Herre's interesting account of these species illustrates very clearly that "some form of isolation or habitudinal segregation is the condition of the development of a new species (Regan)". It further shows that "as a rule the first step in the origin of a new species is the formation of a community with a new and restricted environment, or with new habits" (Regan). Dr. Herre concludes that "From the outline given it can be seen that the fishes of the Lanao plateau present a highly interesting problem to the student of evolution, one which would repay an intensive study. Something has been presented here from the unfashionable viewpoint of the field naturalist, in the hope that some modern technician might take up the study of the *Lanao cyprinidæ*."

S. L. H.

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THE HOUSE THAT FREUD BUILT. By Joseph Jastrow, PH.D., LL.D. (Rider & Co., Paternoster House, London, pp. 252. Price 7*s.* 6*d.* net.)

When the theory of the "unconscious" was announced, Dr. Sigmund Freud was acclaimed as the Darwin of the human mind and among the numerous ramifications to which this fruitful generalisation gave rise, the general public is most familiar with the principle of psychoanalysis. The Œdipus complex—one of the numerous complexes developed by this doctrine—it is well known to literary circles, seems to have provided a satisfactory explanation of the hesitancy of Hamlet in killing his mother, as expressed in his famous soliloquy, and numerous instances from Red Gauntlet, Tom Jones and other novels must occur to the reader's mind as illustrations of some principle or other of Freudian psychology, which also provides an answer for obscure mental phenomena like hysterical obsessions, slips of tongue and pen and dream experiences. The cause for their manifestation is that during waking hours, the mental censor is imposing restraints on the repressed antisocial wishes which lie dormant in the mind and when the censor is caught napping, as during sleep or moments of unawareness, they find a symbolic expression. Similarly, fear due to any terrible accident which one might have forgotten, may, at the suggestion or repetition of the dreadful experience, be regarded as a factor in producing paralysing effect on the mind and body. Freudianism conceives the human mind as a sewer the contents of which are reprehensible wishes and dreadful fears of childhood experiences of which it is not in ordinary moments aware, or dare express in society and the sewer is enriched every time such wishes, fears and hallucinations are repeated.

The book subjects this fashionable doctrine of psychoanalysis to a critical investigation and its immediate purpose is to examine the symptoms and their interpretation in the Freudian exegesis. The first part of the book is devoted to a statement of the facts and principles of the Freudian system which in its ramifications is intended to cover the entire range of the human psyche.

The second part is devoted to a critical examination of the foundations and the superstructure of this edifice and the inevitable conclusion is reached that they are based on untenable assumptions and fallacies. The psychoanalysts adopt the principle that everything is sex and sex is overall. The human mind and its motives are also something nobler in their intellectual, emotional and spiritual relations and operations and although the sex instincts impart a tinge to some of their manifestations, it would be illogical and unscientific to see sex and nothing else in all human actions, thoughts and even dreams. The second part of the book is a protest against the sex-jaundice of the followers of Freud and the dispassionate reader is left in no doubt as to the attitude of Jastrow who finds not even the slightest warrant of biological, physiological and psychological justification for Freudian illogicalities. Stripped of all the grosser accretions and extravagances, the main hypothesis is certainly a notable contribution to genetic psychology. The technique devised by the psychoanalysts is no healing balm to mental disorders and persistence in this madness must be a hindrance to the orderly and scientific progress of our understanding of the deep-seated troubles arising from more causes than those of the suppressed memories of infantile sex experiences. Psychoanalysis has become a dogma and threatens to hinder the free growth of knowledge.

The book is written in a perfectly frank and scientific spirit. The style is clear and vivid. The arguments are perfectly logical and cogent. The weak points of Freudian psychology are exposed without animus. Its strong features are supported without hesitation. The book helps the reader "to absorb that part of Freud which is most helpful to straight thinking and pleasant living." We have pleasure in praising the excellence of the book and in congratulating the author on his splendid performance.

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THE PSYCHOLOGY OF POWER. By J. A. Hadfield, M.A., Macmillan & Co., Ltd., St. Martin's Street, London, 1933. Pp. 1-49. Price 1*s.*)

This interesting booklet represents a new edition of the paper originally contributed by the author to *The Spirit* (1919) one of the popular series of volumes produced by the "Cumnor Group" and is intended to meet a widely-expressed demand for its republication. The main question which this essay purports to solve is whether energy comes from within ourselves as we acquire it from food and periodic rest or are we mere channels of energy, which is to be regarded as some impulse that works through

us and is not of our making. This is undoubtedly a fascinating problem for spiritualists, theosophists and introspective philosophers and the terms of the question are not strictly scientific in the sense that they are capable of experimental treatment. The liberation of energy in excess of the normal under hypnotic suggestions is not an argument in support of the thesis, for the subject under their influence is drawing upon his reserve. If highly seasoned food should whip up the replete stomach to put forth fresh effort, the glutton relies more upon the mechanical properties of this organ than on those of spices to accommodate the additional mass. Hadfield's view that man's ultimate energy is derived from cosmic source may satisfy certain schools of thought represented by speculative philosophers and it offers no explanation to the significance of the chemical reactions of the tissues and the cells being regarded as the storehouse of energy.

In the section on fatigue, we are told that irritability, want of confidence, worries and anxieties are a fruitful cause. But the common denominator of all these causes is "monotony" and if this element could by any possible means be eliminated from professions and occupations, Hadfield's causes of "fatigue" will disappear.

The subject of energy is part of physiology and not of psychotherapy. The book will be welcomed by all interested in psychic researches.

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ECONOMIC MAMMOLOGY. By Junius Henderson and Elberta L. Craig. (Bailliere, Tindall & Cox, 7-8, Henrietta Street, Covent Gardens, London, W.C. 2. Pp. 397. Price 22*s*. 6*d*.)

We have read this sumptuous book with considerable interest and profit and it will doubtless be found extremely useful not only to students of biology but also to those engaged in trade and manufacture and to statesmen in charge of public finance. The wealth of information presented within the compass of 347 pages ranges over an immense field and its usefulness to the economist, statistician, sportsman and the general reader can hardly be over-estimated. The first part of the book deals with facts and principles relating to economic mammology and the second part is devoted to a systematic discussion of the several groups comprising this class of animals, together with statistical data and references to literature.

The man in the street can hardly realise the important rôle played by mammals in his social and political economy. The different kinds of meat forming the world's daily menu, the milk and milk-products, fats and oils, wool, furs, skins, horns and antlers, teeth, animal compost, bone meal and fertilizers constitute a great part of the industrial organisation of the country and a source of national wealth. There are a few mammals like the rodents which destroy the crop and others like the carnivores, prey upon fish and fowls and other animals in the service of man. Hitherto the interest of the Government has been confined to the taxation of the industries and the exports and imports of the mammalian products. The indiscriminate zeal of sportsmen in the pursuit of their pleasure has disturbed the balance of nature whose consequences to science and industry he can hardly judge. The theory that wild animals of economic importance are part of the property of the state and are therefore entitled to protection has been recognised only recently and the laws framed for this purpose are not generally honoured in the observance. The study of mammals as useful scavangers, as carriers of diseases, as practical agriculturists in turning over the soil, as agents in causing erosions or in endangering dams, dykes and reservoirs and the part they play in offering inducements to exploration of virgin lands and their occupancy by settlers, is not only a chapter in the romance of Natural History, but is a fundamental section of economics. The central fact in American History and the expansion of the early settlers over the whole continent is closely bound up with that little animal called beaver. Similarly, whales and whaling industry have played an important part in the exploration and international disputes. Mammals have unconsciously influenced the fashions and artistic tastes of man whose whole course of civilisation is related in a considerable measure to wild life.

The importance of the book to the tradesman, economist, politician, biologist and to every one who claims to be educated, is invaluable.

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INORGANIC COLLOID CHEMISTRY. Vol. 1, The Colloidal Elements. By Harry B. Weiser, Professor of Chemistry at the Rice Institute. (New York: John Wiley & Sons, Inc. London: Chapman and Hall, Limited, 1933. Pp. xi+389. Price 28*s*. net.)

Apparently the author—who must be familiar to colloid chemists as the editor of the series of Colloid Symposium Monographs (appearing since 1930 as the Colloid Symposium Annual)—feels a need for stressing a difference of outlook in the field of colloid science, and indeed the object of the author is to "emphasise the importance of colloid chemistry of the elements and their inorganic compounds" to the student of inorganic chemistry. Actually the book will be welcomed by all students of chemistry, and particularly by those who are not already specialists in this branch of research, as it includes an admirably clear, concise, and critical presentation of the theories and some of the applications of colloid science.

The present book forms volume I of the subject, and is concerned mainly with the colloidal elements and the important rôle they have played in the development of the theories. "After a chapter dealing with the general methods of preparation, separate divisions of the volume are devoted in turn to the metals and the non-metals. In so far as practicable the several elements are taken up in the order in which they appear in the periodic table. In the descriptive portions of the text are included the methods of procedure for preparing the several sols and for investigating their characteristic colloidal properties", and in several cases enough experimental details are given for guidance in laboratory work. The first part dealing with the metallic elements includes a useful 30 pages devoted to the theory of adsorption of gases by metals, and another 40 pages to the theory and use of colloidal metals as contact catalysts. In the second part dealing with the non-metallic elements, carbon, sulphur, selenium, tellurium, and iodine, there is a critical 30-page survey on adsorbent carbon. There are more than a thousand foot-note references to the literature, many of them to important papers that have appeared in the last few years, which will serve as a valuable guide to original research.

The book is by no means a mere compilation. The major part of it can be read with pleasure. There are a number of diagrams which are excellently drawn and aid in the clarity of presentation. All told the volume is a welcome addition to the existing books on Colloid Chemistry. G.R.

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CHEMISTRY AND PHYSICS FOR BOTANY AND BIOLOGY STUDENTS. By E. R. Spratt, D.Sc., F.L.S., A.K.C. (University Tutorial Press, Ltd., 1933, Second Edition. Pp. vi+284. Price 3*s.* 6*d.*)

This book is designed to provide the material for a course of instruction in Elementary Physics and Chemistry for students of Elementary Botany and Biology of the Oxford and Cambridge School Certificate Standard.

Twelve out of the 21 chapters of the book deal with Elementary Physics: Properties of Matter, 6; Heat, 4; Light, 1; and Electricity and Magnetism, 1. The remaining nine chapters are devoted to a study of Elementary Chemistry: Physical Chemistry, 2; Inorganic Chemistry, 5; and Organic Chemistry, 2.

The subject-matter of each chapter has been presented in a very intelligible fundamental manner combining theoretical statements with practical illustrations in the form of simple experiments which can be easily carried out with inexpensive apparatus. Directions for carrying out seventy-nine such experiments are given under the chapters on Physics and eighty-nine such, under Chemistry.

The comprehensive yet elementary character of the subject-matter will be clear from the nine experiments under the chapter on "Light" which illustrate the Pinhole Camera, the Reflection at Plane and Spherical Surfaces, Refraction and Refractive Index; properties of lenses and microscopes and production of spectral colours. The essentially practical and realistic feature of the experimental material is best brought out by the two experiments under Organic Chemistry which describe the production of gas, liquor, tar and charcoal by the dry distillation of coal and other vegetable matter.

The book is throughout adequately illustrated with 128 diagrams of apparatus used for the various experiments. Very few errors are noticeable except perhaps the use of the terms "Adhesion" and "Cohesion" on pages 5 and 6; "Alcoho" for "Alcohol" on p. 246 and the equation on pp. 162 and 177, $CaO+H_2O$ which is better written as $Ca(OH)_2+CO_2 \rightarrow CaCO_3+Aq$.

The book bears full evidence of being the work of an experienced teacher and can confidently be recommended for adoption in Indian schools as a suitable aid to impart the essential preliminary knowledge of Physics and Chemistry to students of Elementary Botany and Biology.

V. P. R.